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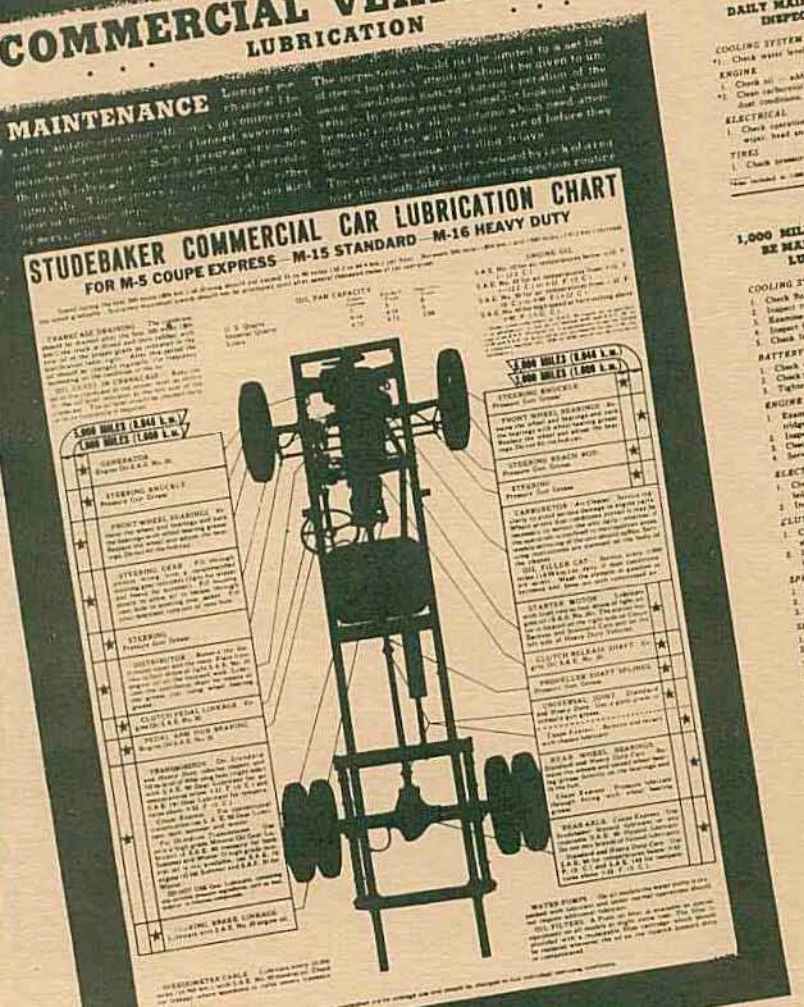
Studebaker

Commercial Car and Truck

SHOP MANUAL

"M" SERIES



Studebaker COMMERCIAL VEHICLE LUBRICATION AND INSPECTION CHART

"M" SERIES . . . SUGGESTED INSPECTIONS . . .

DAILY MAINTENANCE INSPECTION

COOLING SYSTEM
*1. Check water level.

ENGINE
1. Check oil — add as necessary.
*2. Clean carburetor air filter as required by dust conditions.

ELECTRICAL
1. Check condition of horn, windshield wiper, head and tail lights.

TIRES
1. Check pressures.

*Not included in 1,000 mile inspection.

1,000 MILE INSPECTION TO BE MADE AT TIME OF LUBRICATION

COOLING SYSTEM
1. Check fluid level.
2. Inspect radiator for leaks.
3. Inspect radiator hoses and connections.
4. Inspect for leaks at water pump.
5. Check fan belt adjustment.

BATTERY
1. Check water level.
2. Check tightness and condition of terminals.
3. Tighten carrier bolts.

ENGINE
1. Examine oil dipstick to see if filler cartridge should be replaced.
2. Inspect and clean fuel pump sediment bowl.
3. Check for engine oil leaks.
4. Service carburetor air cleaner.

ELECTRICAL
1. Check tightness of generator attaching bolts.
2. Inspect wiring — and connections.

CLUTCH
1. Check pedal for lash and travel. Pedal should have minimum of ½" free travel.
2. Inspect corner keys in clutch and brake hook-up.

SPRINGS
1. Check for loose spring saddle bolts.
2. Check for broken spring leaves.
3. Tighten spring "U" bolts.

SHOCK ABSORBERS
1. Inspect for leakage.
2. Check condition of link bushings.

TRANSMISSION AND REAR AXLE
1. Check for lubricant leakage.

PROPELLER SHAFTS AND "U" JOINTS
1. Inspect propeller shaft support bearing.
2. Check and lubricate universal joints.

MUFFLER
1. Check condition.
2. Inspect muffler outlet pipe.
3. Examine exhaust pipe mountings.

STEERING
1. Examine condition of rubber insulators on steering gear arm.
2. Inspect steering connections for loose or worn ball joints.

BRAKES
1. Check brake system for leakage.
2. Check brake pedals for lash and travel.
3. Inspect parking brake cables.

WHEELS
1. Test for loose front wheel bearings.
2. Check bearing lubricant — all wheels.

TIRES
1. Check pressures. Examine universals.

2,000 MILE INSPECTION AND ADJUSTMENTS

COOLING SYSTEM
1. Check water level and inspect radiator for leaks.
*2. Examine radiator hoses and connections.
*3. Check operation of water pump — inspect for leaks.
*4. Check fan belt adjustment.
5. Tighten radiator and radiator shell bolts.

ELECTRICAL SYSTEM
*1. Test battery and check water level.
*2. Check battery terminals.
*3. Tighten battery carrier bolts.
*4. Tighten generator attaching bolts.
*5. Check generator charging rate.
*6. Inspect wiring. All electrical connections should be clean, dry and tight.
7. Check operation of windshield wiper, head and tail lamps.
8. Adjust ignition timing.

ENGINE
1. Drain crankcase and refill with proper grade of oil.
*2. Service carburetor air cleaner.
*3. Clean fuel pump sediment bowl.
4. Tighten exhaust pipe flange bolts.
5. Tighten engine support bolts.
*6. Check for engine oil leaks. Inspect oil filter cartridge. When oil filter cartridge is renewed, tighten oil filter cover.
7. Adjust carburetor choke and valve stops.

CLUTCH
*1. Check pedal for lash and travel. Pedal should have minimum of ½" free travel.
*2. Inspect corner keys in clutch hook-up.

SPRINGS
*1. Check for loose spring saddle bolts.
*2. Check for broken spring leaves.
*3. Tighten spring "U" bolts and spring clips.

SHOCK ABSORBERS
*1. Inspect for leakage — (Check operation. Check condition of link bushings.

TRANSMISSION
1. Check for lubricant leakage.

MUFFLER
*1. Inspect mountings, outlet pipe — inspect support bolts, pipe for stoppage condition such as rust clogging, kinks, etc.

PROPELLER SHAFTS AND UNIVERSAL JOINTS
*1. Inspect propeller shaft support bearing. Flanges and joint bearings — lubricate points.

STEERING
1. Examine steering gear and linkage. Adjust as necessary.
*2. Inspect steering connections for loose or worn ball joints.

BRAKES
*1. Inspect service brakes for pedal travel.
2. Check fluid in master cylinder.
*3. Examine parking brake cables and linkage as necessary.
*4. Check brake [illegible]
5. If Bowden wire [illegible] linkage, [illegible]

WHEELS
*1. Test front wheel [illegible]
*2. Check [illegible]

TIRES
*1. Check tire pres[illegible]

*Not included in 1,000 mi[illegible]

5,000 MILE INSPECTION AND ADJUSTMENTS

(NOTE: These items are in addition to the 2,000 Mile Inspection Operations.)

COOLING SYSTEM
1. Drain, reverse flush and add rust inhibitor.

ELECTRICAL SYSTEM
1. Clean and adjust spark plugs — set at .025".
2. Clean distributor points — set at .025".
3. Check ignition wiring. Set ignition timing using a timing light.
4. Inspect generator brushes. Clean and remove.
5. Check starter motor operation.

ENGINE
1. Check valve tappet clearance — adjust valve tappets with engine cold.
2. Inspect crankcase breather pipe. Remove breather cap for cleaner packing.
3. Examine condition of oil lines and flexible lines.
4. Renew oil filter cartridge. Tighten filter cover.
5. Tune engine.

Perform following operations with engine hot and running:

1. Check manifold heat control.
2. Test cylinder compression, engine vibration, performance for pull, acceleration and oil pressure.
3. Tighten cylinder head to correct pressure with torque wrench and tighten manifold bolts.

GASOLINE
1. Inspect carburetor, set float level and throttle adjustment.
2. Check octane selector — for adjustment see 1941 Passenger Car Shop Manual.
3. Adjust carburetor and clean bowl and sediment chambers in fuel tank.
4. Clean gasoline strainer and carburetor.
5. Tighten gasoline tank bolts.
6. Check fuel pump pressure and operation.

CLUTCH
1. Inspect linkage, rod ends and pins.

SPRINGS
1. Tighten mounting bolts, connecting link bolts and rear clip nuts.
2. Inspect bushings and ball joints for wear.

SHOCK ABSORBERS
1. Check fluid level — refill if necessary.

STEERING
1. Check front wheel alignment and turning radius with tires inflated.
2. Inspect connecting rods and arms for wear. Examine king pins.
3. Check tightness of steering gear attaching bolts.

10,000 MILE INSPECTION AND ADJUSTMENTS

(NOTE: These items are in addition to other Inspections.)

COOLING SYSTEM
1. Check operation of thermostat. If not opening satisfactorily, replace.

ELECTRICAL SYSTEM
1. Install new distributor points and spark plugs — if necessary.
2. Install new generator brushes — if necessary.
3. Replace spark plugs.
4. Check head lamp bulbs, alignment focus.

ENGINE
1. Remove, clean and, if necessary, repair fuel pump. Check fuel pump pressure.
2. Wash and service crankcase breather tube.
3. Inspect oil pan gaskets for breaks or cracks — replace as necessary.
4. Remove and clean oil pan — clean oil strainer.

TRANSMISSION
1. Check transmission and differential lubricant. Drain, flush and refill as necessary.

BODY
1. Check operation of doors and windows.
2. Tighten body and cab hold-down bolts. General chassis tightening.

UNIVERSAL JOINTS
1. Disassemble joints, if necessary, and lubricate.
2. Repack bearing assemblies.

15,000 MILE INSPECTION AND ADJUSTMENTS

(NOTE: These items are in addition to other Inspections.)

ELECTRICAL SYSTEM
1. Test coil. Replace if necessary.

WHEELS AND AXLES
Rear Axle —
1. Check condition of shaft bearings, bearing caps, cone cutters, fit of bearing caps. Make necessary adjustments.
2. Inspect differential bearings, bearing caps and cones. Adjust as necessary.
3. Tighten rear axle shaft and oil conservation.

TWO — SPEED AXLE same as foregoing — and additional
1. Check condition of bevel gear, ball pinion and ball gear.

BRAKES
1. Remove all wheels for brake lining inspection, and replace lining if necessary.

★

These suggested Inspections are based on normal operation. Where vehicle is used under severe conditions, more frequent inspection should be made.

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TUDEBAKER AUTHORIZED SERVICE

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STUDEBAKER

COMMERCIAL CAR AND TRUCK SHOP MANUAL

COVERING "M" SERIES
COUPE EXPRESS • STANDARD • HEAVY DUTY
COMMERCIAL CARS AND TRUCKS

PREPARED BY
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A WORD TO THE DEALER

• The sale of a commercial car is the culmination of hours of effort and hard work on the part of you or your salesman and the customer as well. Presumably the vehicle has been gone over with microscopic attention given to features of its construction, specifications, capacity, etc. Everything which has a bearing on the use of this unit in producing a profit for the buyer has been covered.

Before completing the transaction by making delivery of the unit, however, one more very important step should be taken. When you hand the keys to the buyer, be sure that *he understands everything he ought to know about the satisfactory operation of his car.* Have someone in your organization qualified to do this — salesman or service man — spend fifteen minutes, a half hour or even an hour, if necessary, with the buyer so that he will know exactly what to expect and what is expected of him with reference to service and upkeep of his car.

If you will make this procedure a rigid policy, you will find the investment of this relatively short time one of the best you have ever made. It will bring returns to you in the form of top performance and minimum operating expense of the unit and, consequently, maximum owner satisfaction and cordial relations between the buyer and you. In other words, this will add up to increased goodwill towards both Studebaker and yourself.

Our Commercial Cars represent the engineering skill, creative effort and famed Studebaker craftsmanship, which result from many years of experience in the commercial car field. In the design, construction and assembly of these units, we have endeavored to anticipate the severest operating requirements, with inbuilt qualities of sturdiness, dependability, and economical operation.

Of course, the efficiency and the cost of operation depend largely on the regular attention and care given the cars. No amount of engineering genius, skill or effort could circumvent neglect or disregard of proper care. We have recommended daily attention to certain items, especially when the car is driven in a locality where severe dust conditions are encountered.

For best performance, we urge that factory recommendations be followed.

This is especially true during the breaking in period. During the first 500 miles of operation, speed should not exceed 35 to 40 miles per hour. Then top speeds should be increased only gradually until at least 1,500 miles of operation. Sustained high speeds should not be attempted until after 2,000 to 2,500 miles have been driven. Owners should be carefully instructed on new car operation at the time of delivery.

In the normal operation of these cars, it is only natural that as mileage accumulates, service requirements involving repairs and replacements may be necessary. Car performance and operating efficiency require the use of some materials which will not last indefinitely, and time of replacement depends largely on the usage to which the car is subjected.

It is important, therefore, that every Studebaker service station make available efficient and complete commercial car service facilities, designed to meet the specific needs of customers. Your customers rightfully expect to obtain high grade service from their Studebaker dealers.

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A WORD TO THE DEALER (Cont.)

Service procedures are simplified through use of the Champion engine in Coupe Express and Standard models, and the Commander engine in Heavy Duty units. This manual deals largely with procedure involved in reassembly, and from time to time supplemental information will be dispensed through the medium of Dealer Service Letters and articles in Service Bulletins.

Whenever you write the factory, always include the serial number, motor number, model, mileage, date of purchase and owner's name and address to facilitate handling and to avoid delays.

Throughout the manual, the models are referred to by their respective names, rather than by model symbols, viz: Coupe Express, Standard and Heavy Duty cars, rather than M5, M15 and M16. A key to model references is shown below.

STARTING SERIAL AND ENGINE NUMBERS

	COUPE EXPRESS (M5)	STANDARD (M15)	HEAVY DUTY (M16)
Starting Serial Numbers	001	001	001
Starting Engine Numbers	1M-001	2M-001	3M-001

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ENGINE

GENERAL

• Six cylinder engines are used in all "M" Series Studebaker Commercial cars. The engine used in the Coupe Express and Standard models is the Champion Passenger Car engine developing 80 H. P. at 4,000 R. P. M. The engine used in the Heavy Duty models is the Commander Passenger Car engine developing 94 H. P. at 3,600 R. P. M. For a more detailed description, see the following General Engine Specifications.

ENGINE SPECIFICATIONS

	Coupe Express and Standard	Heavy Duty
Number of cylinders	6	6
Cylinder bore	3" (76,2 mm)	3-5/16" (84,14 mm)
Stroke	4" (101,6 mm)	4-3/8" (111,13 mm)
Piston displacement — cu. in.	170	226
Piston displacement — cu. cm.	2.785	3.703
Horsepower (N. A. C. C.)	21.6	26.35
Maximum Horsepower at R. P. M.	80 @ 4,000	94 @ 3,600
Compression ratio — standard	6.5 to 1	6.5 to 1
Compression pressure at 150 R. P. M.	105 lbs. (47,62 Kgs.)	105 lbs. (47,62 Kgs.)
PISTONS AND RINGS		
Piston material	Tin Plated Aluminum Alloy	Tin Plated Aluminum Alloy
Oil rings per piston	1	1
Width of oil ring	5/32" (3,97 mm)	3/16" (4,76 mm)
Oil ring gap	.007" to .017" (0,178 to 0,432 mm)	.009" to .014" (0,23 to 0,355 mm)
Compression rings per piston	2	2
Width of compression rings	3/32" and 1/8" (2,381 and 3,175 mm)	3/32" (2,381 mm)
Compression ring gap	.007" to .017" (0,178 to 0,432 mm)	.009" to .014" (0,23 to 0,355 mm)
Piston clearance	.0015" Selective Fit (0,038 mm)	.0015" Selective Fit (0,038 mm)
RODS AND PINS		
Pin diameter	3/4" (19,032 mm)	7/8" (22,22 mm)
Pin locked or floating	Locked in rod	Locked in rod
Pin clearance	.0001" to .0003" (0,0025 to 0,0076 mm)	.0001" to .0003" (0,0025 to 0,0076 mm)
Crank pin journal — diameter	1.81175" to 1.81275" (46,02 to 46,04 mm)	2.18675" to 2.18775" (55,54 to 55,57 mm)
Crank pin journal — length	1.123" to 1.126" (28,52 to 28,6 mm)	1-3/8" (34,9 mm)
Connecting rod bearing clearance	.0005" to .002" (0,0127 to 0,050 mm)	.0005" to .002" (0,0127 to 0,050 mm)
Connecting rod bearing end play	.005" to .009" (0,127 to 0,23 mm)	.005" to .009" (0,127 to 0,23 mm)
Rods and pistons removed from	Top	Top
CRANKSHAFT		
End thrust carried on	Front Bearing	Front Bearing
Crankshaft end play	.003" to .006" (0,076 to 0,15 mm)	.003" to .006" (0,076 to 0,15 mm)
Main bearing clearance	.0005" to .0025" (0,0127 to 0,064 mm)	.0005" to .0025" (0,0127 to 0,064 mm)
Main bearing journal — diameters	2.437" to 2.4375" (61,90 to 61,91 mm)	2.4995" to 2.5000" (63,49 to 63,50 mm)
Main bearing journal — length No. 1	1-5/16" (33,34 mm)	1-5/16" (33,34 mm)
No. 2	1-1/8" (28,58 mm)	1-1/8" (28,58 mm)
No. 3	1-1/8" (28,58 mm)	1-1/8" (28,58 mm)
No. 4	1-17/32" (38,9 mm)	1-27/32" (46,83 mm)

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S E C T I O N

	Coupe Express and Standard	Heavy Duty
CAMSHAFT		
Camshaft drive	Gear	Gear
Camshaft journal — diameter No. 1	1.7475" to 1.7480"	1.9975" to 1.998"
No. 2	1.71625" to 1.71700"	1.96625" to 1.967"
No. 3	1.68575" to 1.68650"	1.93575" to 1.9365"
No. 4	1.62325" to 1.62400"	1.12325" to 1.124"
VALVES		
Valve stem diameter	5/16" (7,938 mm)	11/32" (8,73 mm)
Valve lift	5/16" (7,938 mm)	11/32" (8,73 mm)
Operating tappet clearance — Intake	.016" (0,40 mm) cold	.016" (0,40 mm) cold
— Exhaust	.016" (0,40 mm) cold	.016" (0,40 mm) cold
Valve seat angle	45°	45°
Narrowing cutter angle — Top	30°	30°
— Bottom	70° to 75°	70° to 75°
Valve head diameter — Inlet	1-11/32" (34,131 mm)	1-15/32" (37,30 mm)
— Exhaust	1-9/32" (32,50 mm)	1-9/32" (32,50 mm)
Valve spring pressures — Open	77-83 lbs. @ 1-7/16" (36,51 mm)	125-136 lbs. @ 1-3/4" (44,5 mm)
VALVE TIMING		
Tappet clearance	.020" (0,508 mm)	.020" (0,508 mm)
Intake opens	15° before U. D. C.	15° before U. D. C.
Intake closes	49° after L. D. C.	49° after L. D. C.
Exhaust opens	54° before L. D. C.	54° before L. D. C.
Exhaust closes	10° after U. D. C.	10° after U. D. C.
TENSION WRENCH SPECIFICATIONS		
Crankshaft main bearing cap screws	1100 inch lbs. (126,5 M. Kgs.)	1100 inch lbs. (126,5 M. Kgs.)
Connecting rod cap bolt nuts	300-325 inch lbs. (34,5-37,2 M. Kgs.)	650 inch lbs. (75 M. Kgs.)
Cylinder head bolts	600-650 inch lbs. (69-75 M. Kgs.)	1000 inch lbs. (115 M. Kgs.)
Filter cover nut	400 inch lbs. (46 M. Kgs.)	400 inch lbs. (46 M. Kgs.)
Tappet adjusting screw	25 inch lbs. (2,78 M. Kgs.) (Approx. 4 lbs. at end of 6" wrench)	

RECOMMENDED TOOLS FOR COMPLETE ENGINE SERVICING

436	Micrometers—0-4"—0-1, 1-2, 2-3, 3-4, a range of 4 sizes is recommended.
J-1264	Tension Wrench
1-C	Crank Pin Reconditioning Tool
100-LD	Bearing Oil Leak Detector
1	Piston Pin Hone
Model B	Connecting Rod Aligner and Bending Fixture
SL-2	Cylinder Hone
A-68	Cylinder Gauge
173-B or RR-2	Cylinder Ridge Reamer
J-336-A	Piston Fitting Spring Scale and Feeler Stock
PC-4	Piston Ring Tools (3", 3-1/16", 3-1/4", and 3-5/16")
J-1293	Piston Pin Assembling Tool
C-385	Piston Ring Compressor
HM-925	Utility Puller Set
HM-861-Y	Crankshaft and Cam Gear Pusher Set
CF-11	Valve Lifter
U-15	Valve Spring Tester
	Perfect Seal Gasket Cement
	Valve Seat Dial Gauge (HALL)
JN-8	Valve Seat Grinder
620	Valve Refacer
AC-300	Tappet Clearance Feeler Stock .016" —1/2" x 12"
S-196	Dial Test Indicator
HM-591-F	Connecting Rod Expansion Reamer (Coupe Express and Standard Models)
HM-591-D	Connecting Rod Expansion Reamer (Heavy Duty Models)
HM-865	Cam Gear Puller

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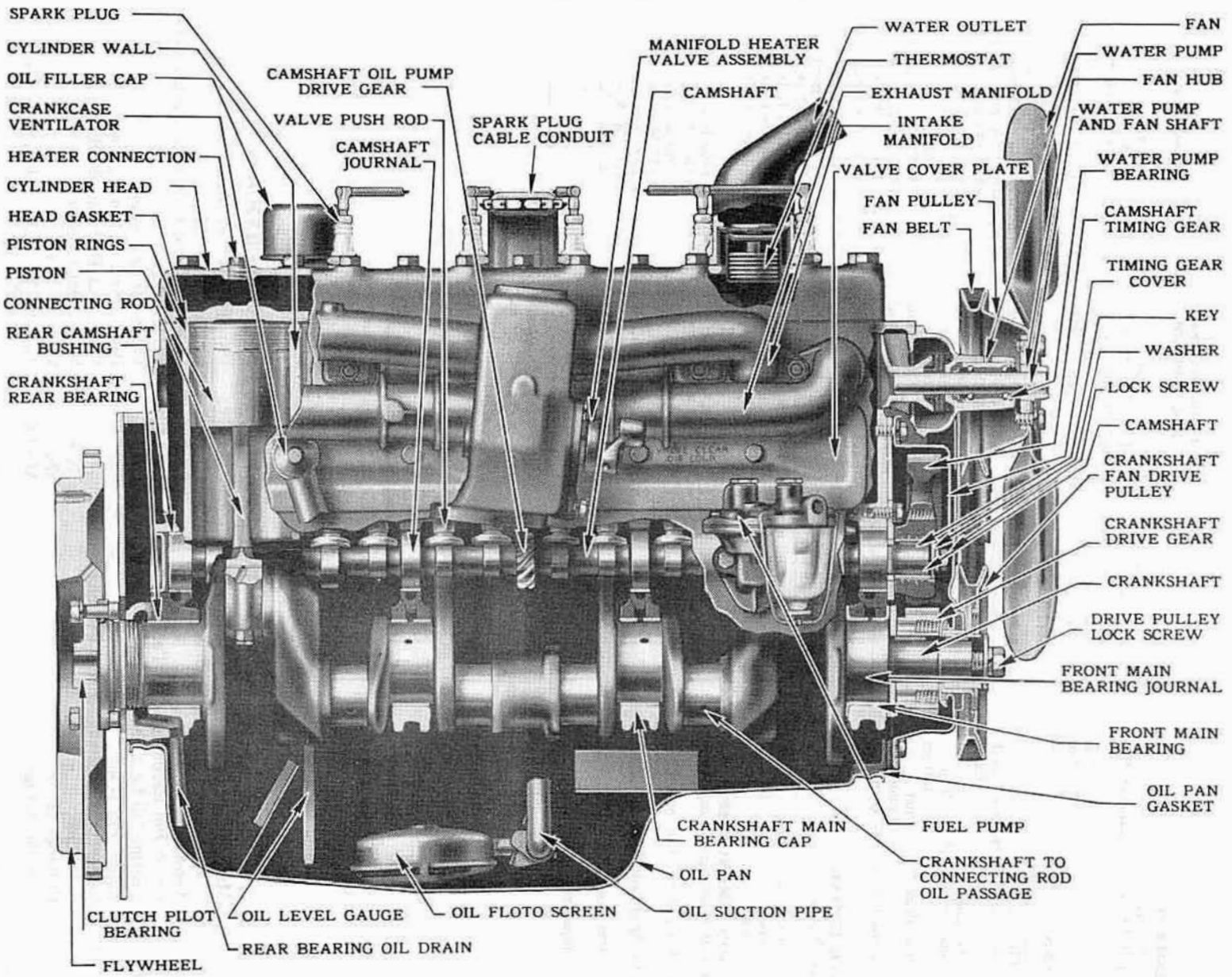
Side view engine — Coupe Express and Standard Models.



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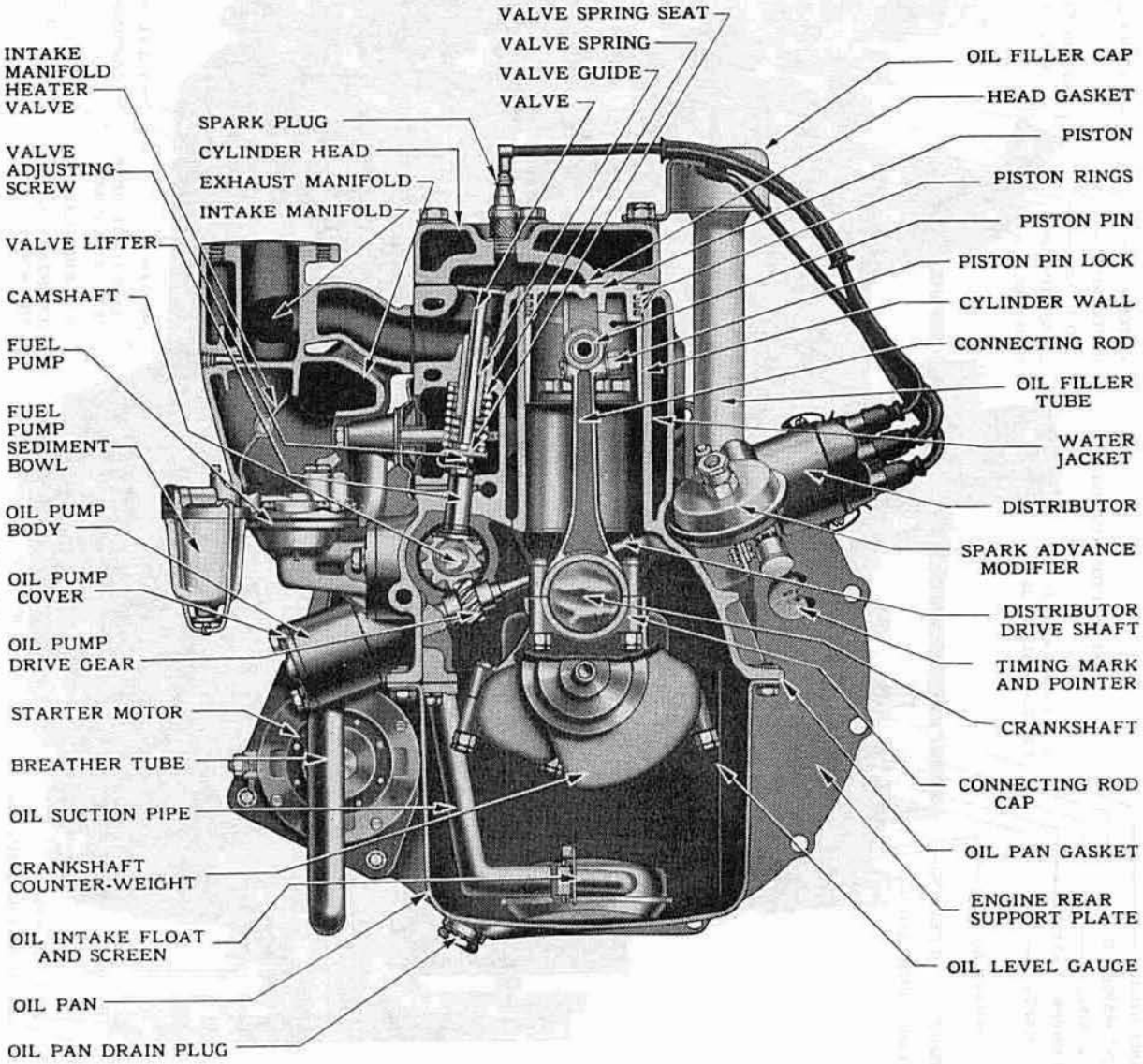
IMPORTANT—For general engine repair work on all models the front end sheet metal assembly, catwalks and front fenders can be easily removed as one piece, by removing the bolts which hold the assembly to the chassis.



End view engine — Coupe Express and Standard Models.

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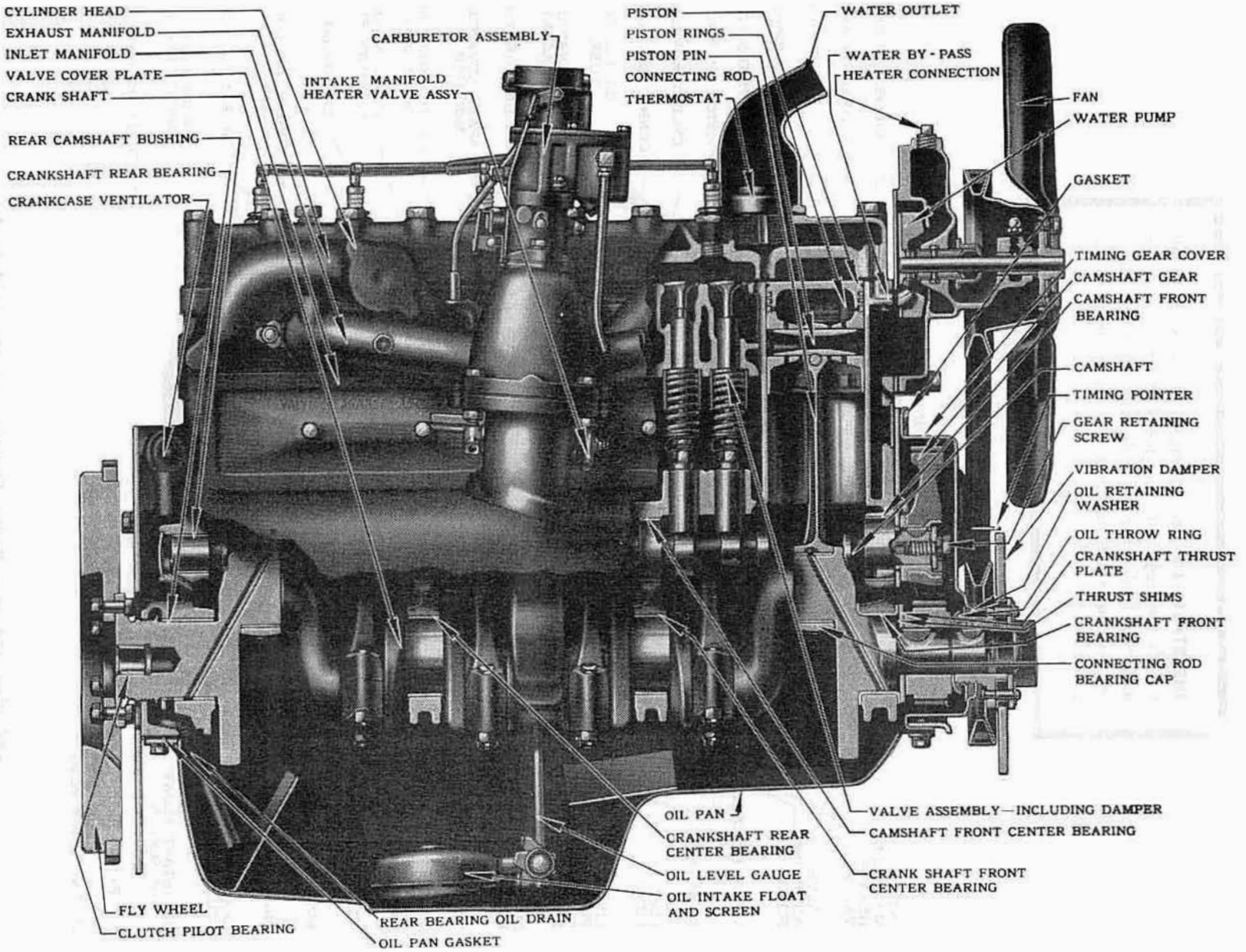
Side view engine — Heavy Duty Models.



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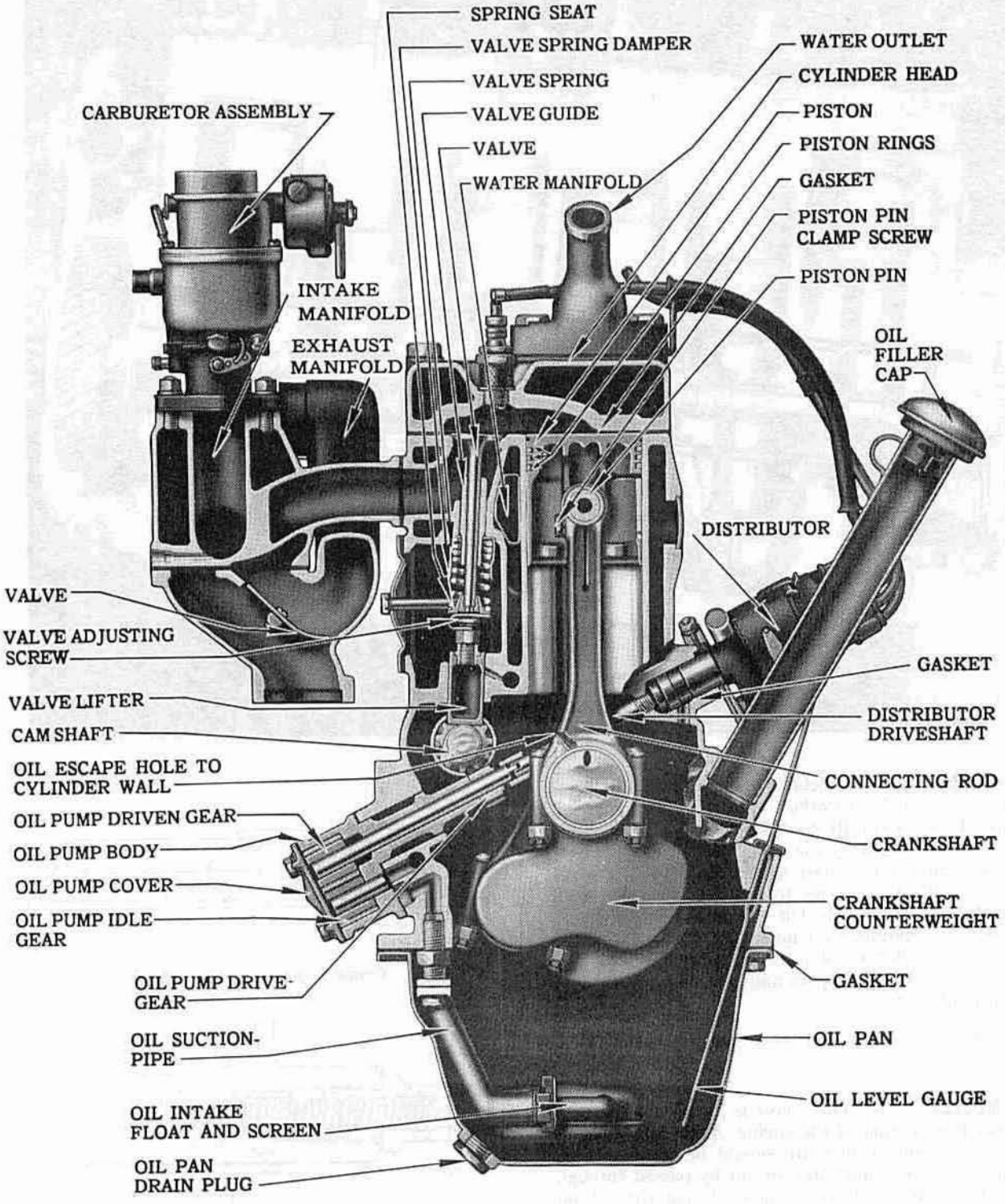

End view engine — Heavy Duty Models.

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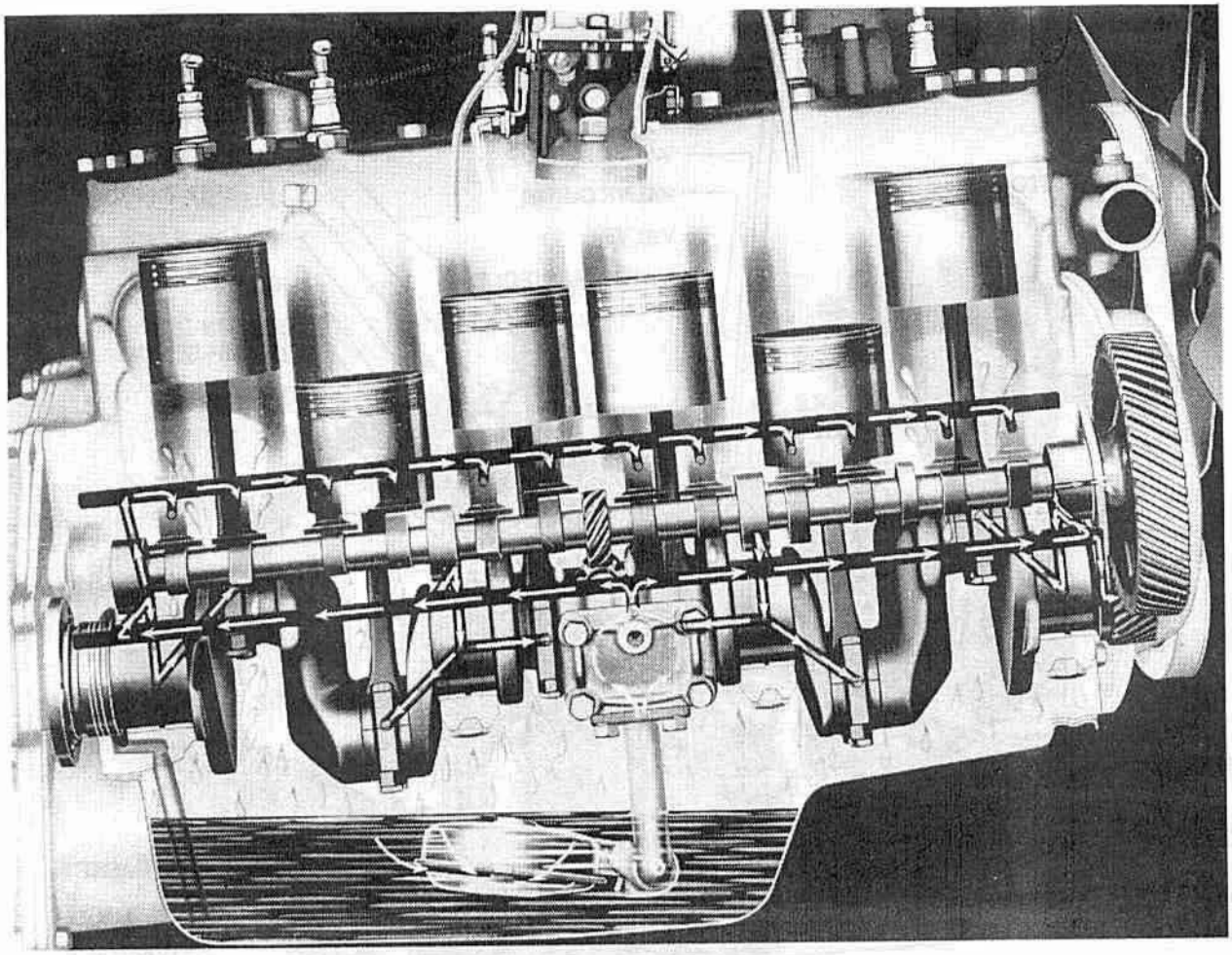
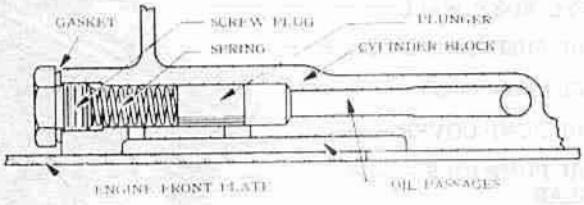
ENGINE OILING SYSTEM

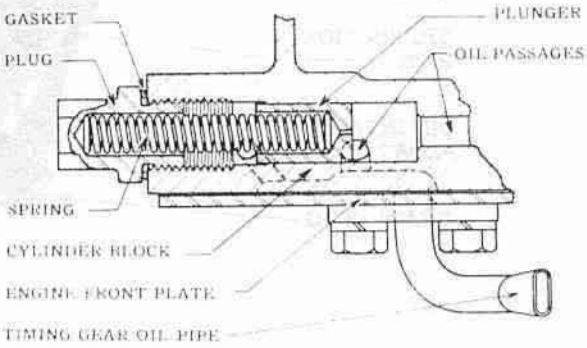


ALL MODELS All Studebaker engines are full pressure lubricated by camshaft driven helical gear oil pumps. To assure positive lubrication to cylinder walls, a jet of oil supplied by the upper half of the connecting rod bearings is forced against the cylinder walls and up inside the pistons to the pins through small holes drilled in the rods. Oil galleries are drilled into the block to eliminate oil lines. Oil by-passed by the oil pressure relief valve provides lubrication for the timing gears. Valve tappets and valve lifters are also pressure lubricated.



Coupe Express and Standard.

ALL MODELS The relief valve is located at the lower right front corner of the engine. At high speed with hot oil the average pressure should be 30 to 40 lbs. Timing gears are lubricated by oil by-passed through the relief valve and by a metered quantity of oil passed through the hole drilled in the valve. If oil pressure is abnormal, check bearing clearances or check for a partially clogged oil line.



Heavy Duty.
Oil pressure relief valves.

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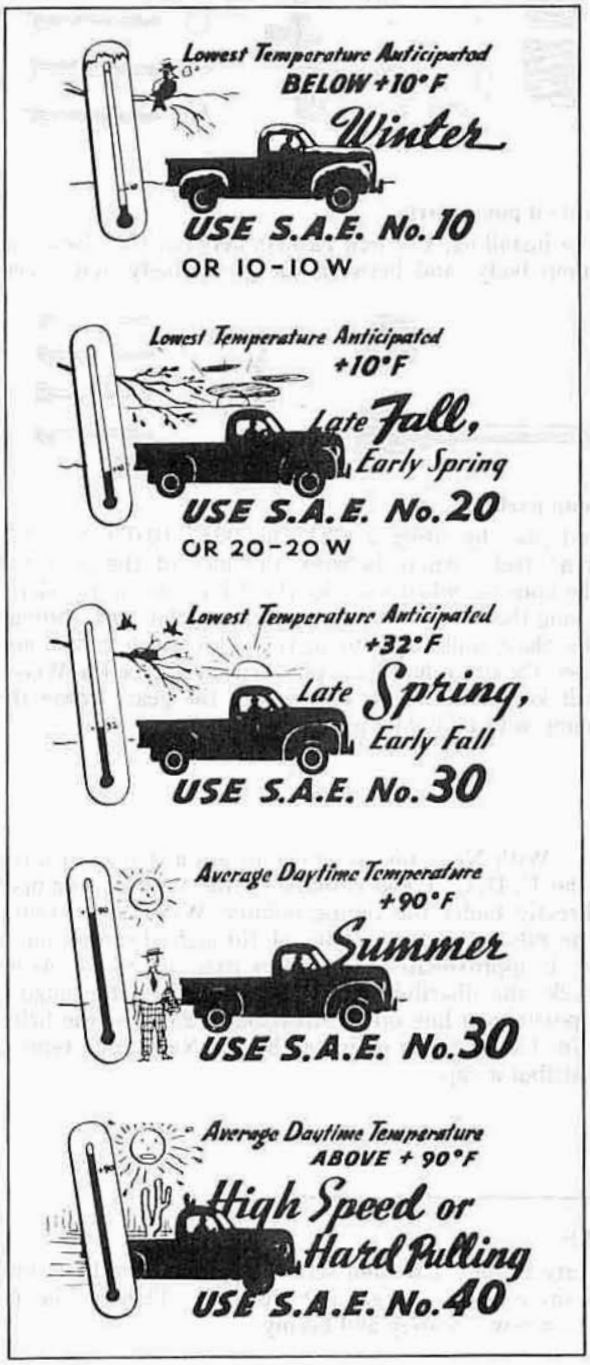
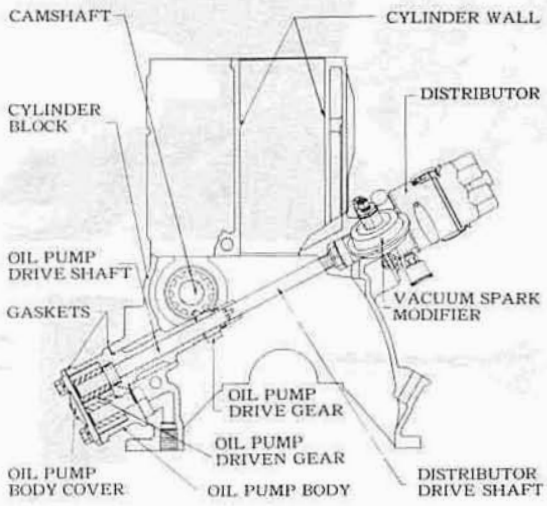
ENGINE OIL VISCOSITY

Capacity Chart		Coupe Express & Standard	Heavy Duty
Capacity—oil pan	U. S. Qts.	5	6
	Imp. Qts.	4.14	5
	Liters	4.73	5.68
Average pressure — high speed		40 (2,8 kgs.)	40 (2,8 kgs.)

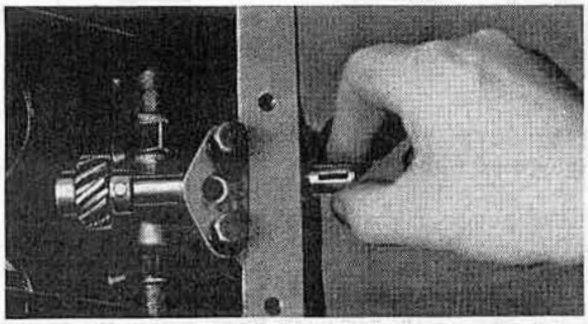
NOTE: Under conditions where an S. A. E. 20 engine oil is specified, it is satisfactory to use an oil labeled "20W and S. A. E. 20." In case of an S. A. E. 10 engine oil, it is satisfactory to use one labeled "10W and S. A. E. 10." Since we do not recommend the use of "W" oils, a container marked only "10W" or "20W" would not be considered satisfactory.



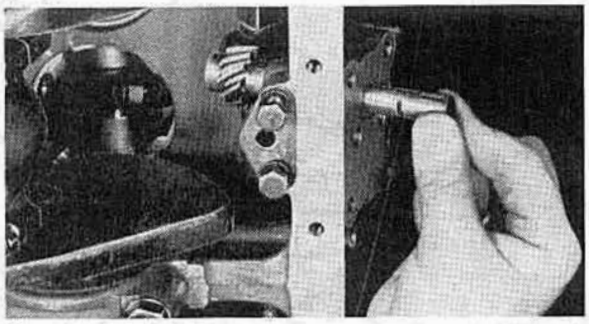
OIL PUMPS



ALL MODELS Helical gear oil pumps driven by the camshaft are used. The oil pump intake is through a floating type oil screen for selection of the cleanest oil. On Heavy Duty models the oil Floto pipe is flanged instead of being threaded. The upper pipe is threaded and its flange should be located parallel with the crankshaft.



COUPE EXPRESS AND STANDARD To obtain the correct ignition timing during assembly, crank the engine until No. 1 piston is in its compression stroke and until the U. D. C. 1 and 6 mark on the flywheel is directly under the timing pointer. Start to engage the drive gear with the camshaft gear. The keyway in the driveshaft should point downward.



COUPE EXPRESS AND STANDARD Pulling the shaft and gear assembly into mesh will rotate the keyway to the rear.

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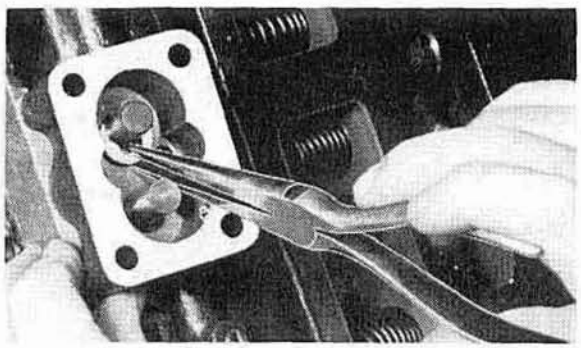
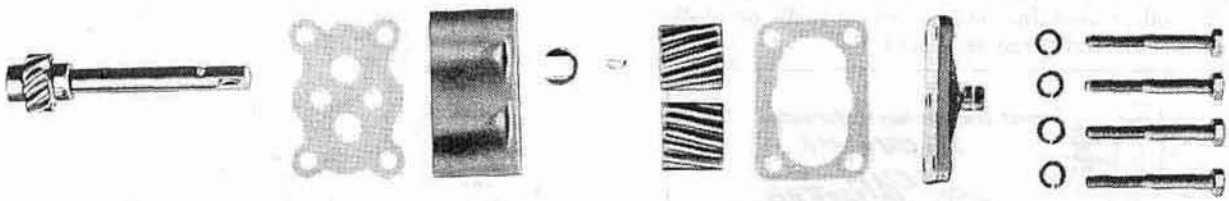
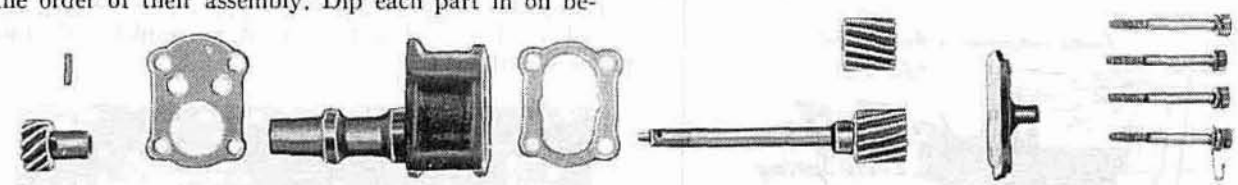


COUPE EXPRESS AND STANDARD Slip the oil pump body over the driveshaft and install the horseshoe lock.



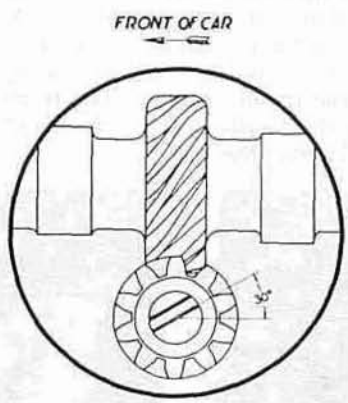
Coupe Express and Standard oil pump parts.

COUPE EXPRESS AND STANDARD Parts of the oil pump used in Coupe Express and Standard Units in the order of their assembly. Dip each part in oil before installing. Use new gaskets between the block and pump body, and between the pump body and cover.



Heavy Duty oil pump parts.

HEAVY DUTY The Heavy Duty model pump can be removed as a unit. It is held in place by the four cap screws which hold the pump body to the crankcase. The oil pump shaft end play of .003" to .005" (0,076 to 0,127 mm) is controlled by the distance between the shaft drive gear and the thrust collar next to the oil pump gear. After installing the new shaft and collar assembly in the oil pump body, obtain the proper end play by using a .003" to .005" (0,076 to 0,127 mm) feeler gauge between the face of the gear and the housing, when pressing the drive gear on the shaft. Using the hole in the drive gear as a pilot, drill through the shaft and ream to 3/16" (4,8 mm), insert and peen the driveshaft gear pin securely. Place the Woodruff key in the shaft and install the gear. Prime the pump with oil before using it.



HEAVY DUTY With No. 1 piston on compression stroke, turn the engine until the U. D. C. 1 and 6 mark on the vibration damper flywheel is directly under the timing pointer. With the oil pump in position the offset tongue, as viewed through the distributor mounting hole, is approximately 30 degrees from horizontal. As an additional check, the distributor can be installed on the engine. It should be possible to line up the distributor rotor at the firing position for No. 1 cylinder as indicated by the No. 1 high tension wire of the distributor cap.

OIL PANS

ALL MODELS On Coupe Express and Standard models, examine the front plate gasket and replace it if necessary. A one-piece oil pan gasket is used on Heavy Duty models. Use pilot screws to guide the oil pan into position after gaskets are installed. Tighten the oil pan screws securely and evenly.

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CRANKSHAFT AND MAIN BEARINGS

ALL MODELS The crankshafts used in the Coupe Express, Standard, and Heavy Duty models are extra strong, perfectly balanced, and machined to a mirror finish on the bearing journals. Four removable steel-backed main bearings, lined with babbitt, support the crankshafts in all engines.

A crankshaft connecting rod bearing journal which is worn, tapered, out of round, or scored in excess of .0015" (0,038 mm) may be reconditioned without removing the crankshaft from the engine. This reconditioning should be performed only when it has been determined beforehand that the main bearing journals are not damaged and all oil passages are clear. Because even well-equipped shops cannot duplicate the precision machining and fine finishes found on Studebaker production parts, it is recommended that a worn crankshaft be replaced on an exchange basis with a new one obtained from the nearest Branch Parts Depot or the Studebaker Parts and Accessories Division. Experience through correspondence with the Claims Division will show it is less expensive and far better to replace a crankshaft than to recondition it.

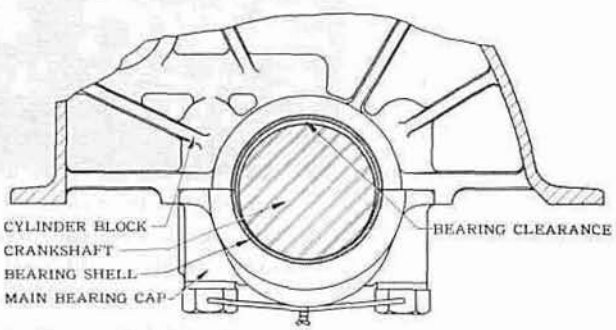
CRANKSHAFT JOURNAL MEASUREMENTS

	Main Bearing Journal Diameters	Connecting Rod Journal Diameters
Coupe Express	2.437" to 2.4375" (61,89 to 61,91 mm)	1.81175" to 1.81275" (46,02 to 46,04 mm)
Standard	2.437" to 2.4375" (61,89 to 61,91 mm)	1.81175" to 1.81275" (46,02 to 46,04 mm)
Heavy Duty	2.4995" to 2.5000" (63,487 to 63,50 mm)	2.18675" to 2.18775" (55,54 to 55,57 mm)

ALL MODELS Main bearings are available in Standard size, .010" U. S., .020" U. S., and .030" U. S.

Connecting rod bearings are available in Standard size, .010" U. S., and .020" U. S.

To recondition the crankshaft and install undersized main bearings, the journal diameter should be reduced from the original dimension by the amount of undersize. For example: if .010" (0,254 mm) undersize main bearings are to be installed in a Coupe Express engine, the original journal diameter of 2.437" to 2.4375" (61,89 to 61,91 mm) should be ground to the exact limits of 2.427" to 2.4275" (61,64 to 61,66 mm).



The clearance between the crankshaft and main bearings is .0005" (0,0127 mm) to .0025" (0,064 mm) on all models. As illustrated on Page 13, bearing caps should not be filed to compensate for excessive clearances.

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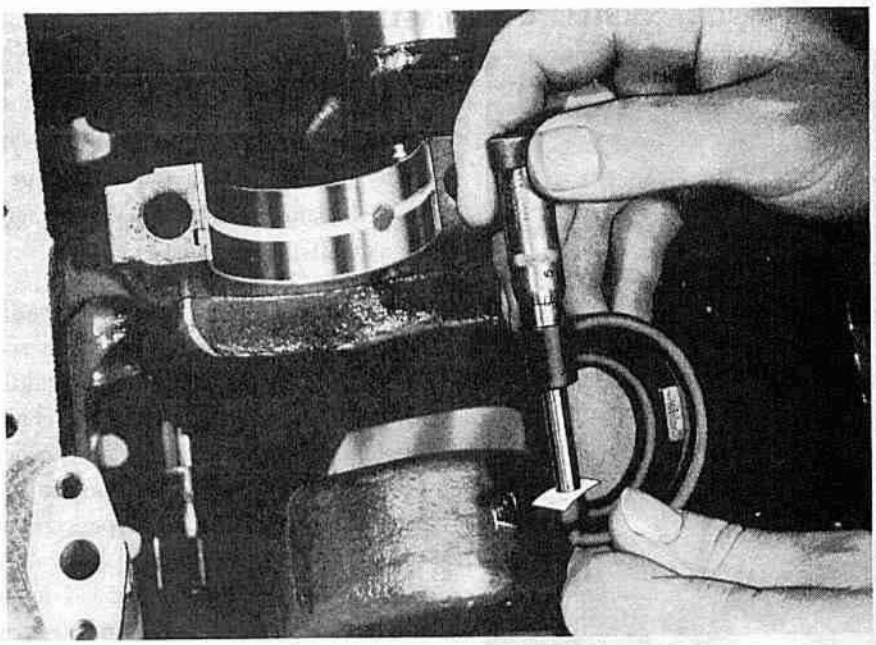
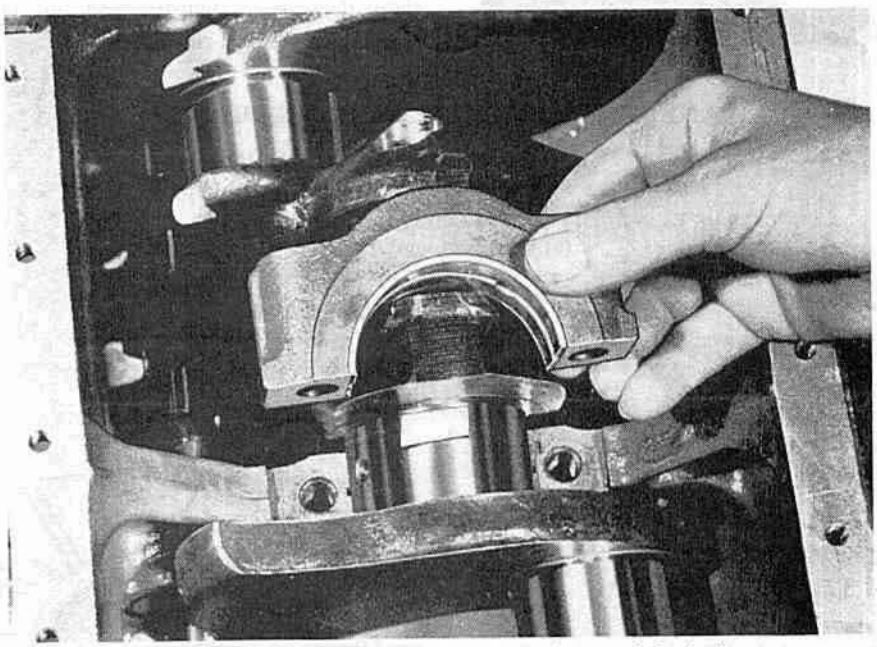


When measuring crankshaft bearing clearance, always clean thoroughly the journal and bearing. Select paper of various thicknesses — .002", .003", .004", (0,0508 0,076 0,102 mm), etc.



After placing a piece of paper on the crankshaft, install the bearing cap and tighten the cap screws securely. (Refer to TENSION WRENCH SPECIFICATIONS — Page 5.) If the crankshaft turns freely, the bearing clearance is greater than the thickness of the paper used. Repeat the procedure, using a thicker piece of paper. Of course, a thinner paper should be selected if the crankshaft cannot be turned or heavy drag exists. When a paper of thickness equal to the bearing clearance is used, a slight resistance will be noted as the crankshaft is rotated.

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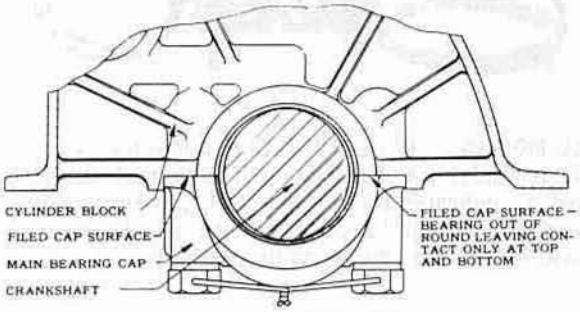
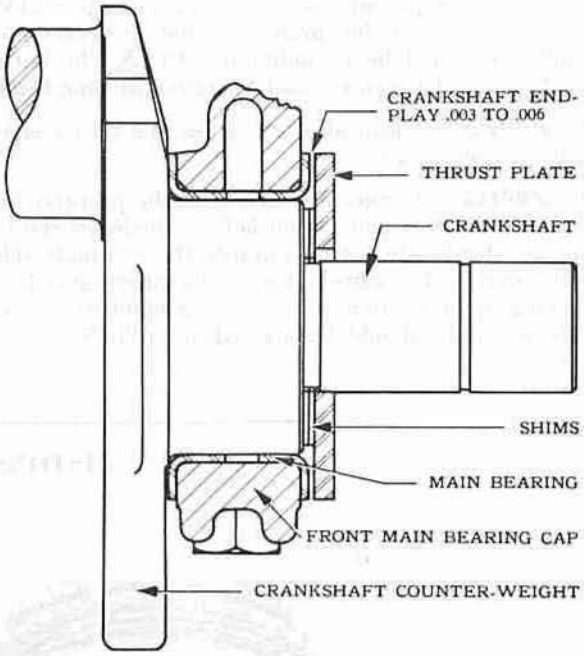
ALL MODELS A specially treated wood oil seal is used at the rear main bearings. Whenever the cap is removed, new seals should be used.


CYLINDER BLOCK
FILED CAP SURFACE
MAIN BEARING CAP
CRANKSHAFT
FILED CAP SURFACE — BEARING OUT OF ROUND LEAVING CONTACT ONLY AT TOP AND BOTTOM

ALL MODELS Never file bearing caps to compensate for excessive bearing clearances. Filing the caps would make contact at the top and bottom, but would not take care of the sides. Bearings with excessive clearance should be replaced.

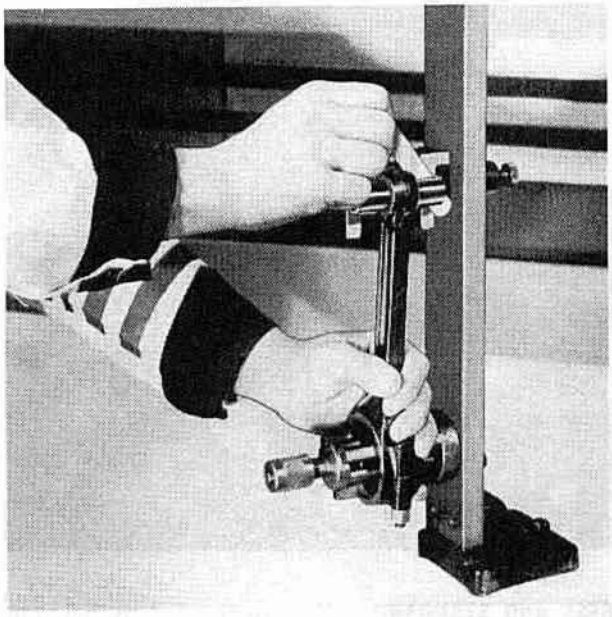
ALL MODELS Use a tension indicating wrench for tightening main bearing cap screws. Tighten to a tension of 1100 inch-pounds (126,5 M. Kgs.).

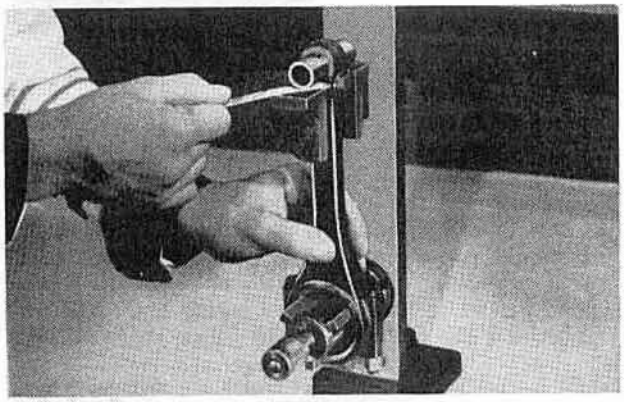


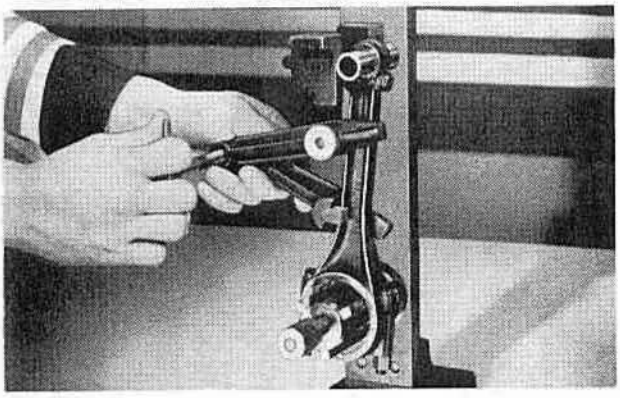
ALL MODELS Initial crankshaft end play adjustment is from .003" to .006" (0,076 to 0,152 mm). Crankshaft end play is adjusted by removing or replacing shims behind the thrust plate.

Revised December, 1941

CONNECTING RODS







ALL MODELS When a connecting rod is replaced, align the piston pin so the piston will be exactly perpendicular to the crankshaft journal. Alignment can be checked with the Ammco Model B Connecting Rod Aligner and Bending Fixture. Misalignment should be corrected with the approved bending fixture.

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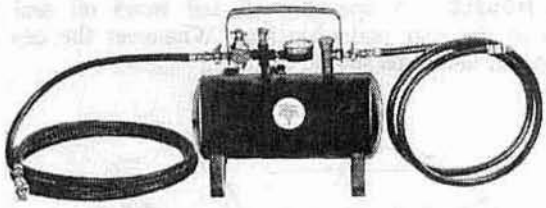
ALL MODELS When replacing the connecting rods, the crank pins should always be examined. If the out of round or taper of the crank pin exceeds .0015" (0,038 mm), or if the surface is rough or scored, the crank pin should be reconditioned. Crank Pin Turning Tool No. 1-C can be used for reconditioning them.

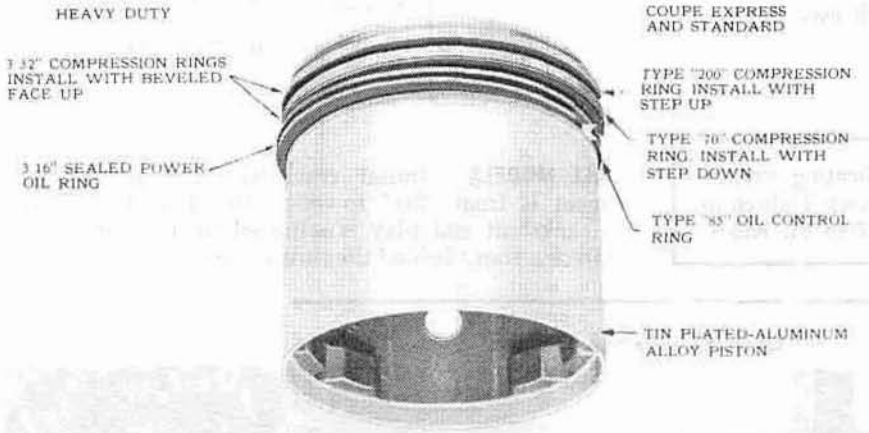
ALL MODELS Clean all oil galleries and oil passages with compressed air.

ALL MODELS Connecting rods must be properly installed. The offset and the oil hole at the lower end of the rod should always be towards the camshaft side of the engine. The camshaft side of connecting rods is stamped in production with the bore number. All replacement rods should be marked accordingly.



ALL MODELS Bearing Oil Leak Detector No. 100-LD is useful for determining if abnormal clearances exist, as indicated by excessive leakage. Any abnormal clearances should be corrected by reconditioning the shaft, if necessary, and installing new bearings.

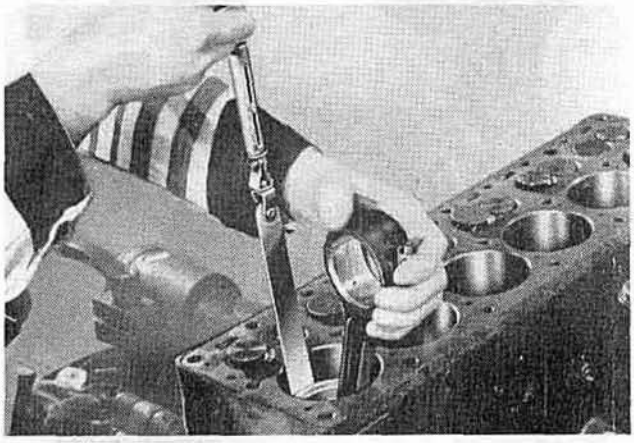
PISTONS AND RINGS

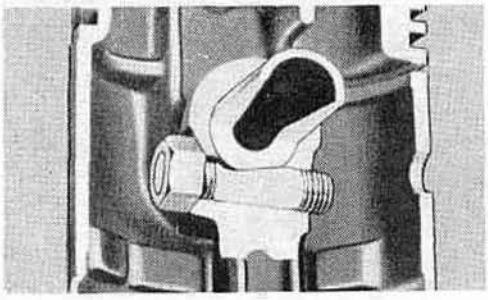

HEAVY DUTY
3 32" COMPRESSION RINGS INSTALL WITH BEVELED FACE UP
3 16" SEALED POWER OIL RING
COUPE EXPRESS AND STANDARD
TYPE "200" COMPRESSION RING INSTALL WITH STEP UP
TYPE "70" COMPRESSION RING INSTALL WITH STEP DOWN
TYPE "85" OIL CONTROL RING
TIN PLATED-ALUMINUM ALLOY PISTON

ALL MODELS The captions on the left apply to Heavy Duty models; while the captions on the right apply to Coupe Express and Standard models. Each piston on all models requires three piston rings. Properly fitted rings should drop freely in the grooves. Lubricate rings, pistons and connecting rod bearing before installing. Space the ring gaps uniformly around the piston.

ALL MODELS To fit pistons use Feeler Stock and Spring Scale J-336-A. With a feeler gauge of proper thickness inserted on the camshaft side of the piston from the top of the cylinder bore, place the piston in the bore in normal position. The slotted side of the piston should be away from the camshaft. Measure the spring scale pull necessary to withdraw the feeler gauge. Proper feeler gauge and spring scale pull with pistons now secured from service stock are as follows:

	Feeler Gauge 1" (25,4 mm) in Width THICKNESS	Spring Scale Pull in Lbs.
Coupe Express and Standard	.002" (0,0508 mm)	11-16 (4,98-7,25 kgs.)
Heavy Duty	.002" (0,0508 mm)	10-15 (4,53-6,80 kgs.)





COUPE EXPRESS AND STANDARD Construction of piston pin lock.

ALL MODELS Piston pins should be fitted to a clearance of .0001" to .0003" (0,0025 to 0,0076 mm). This represents a light finger-push fit at room temperature of about 70° (21° C.).

Revised December, 1941

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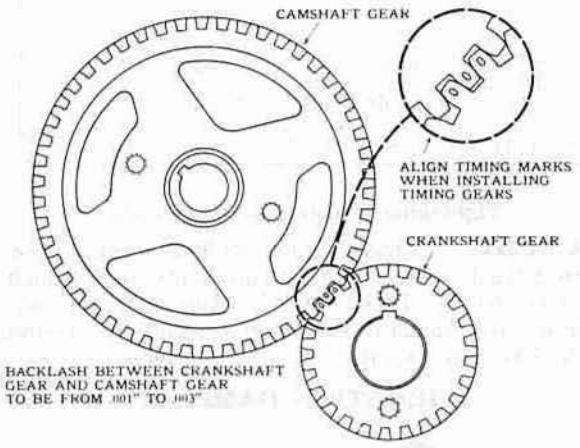
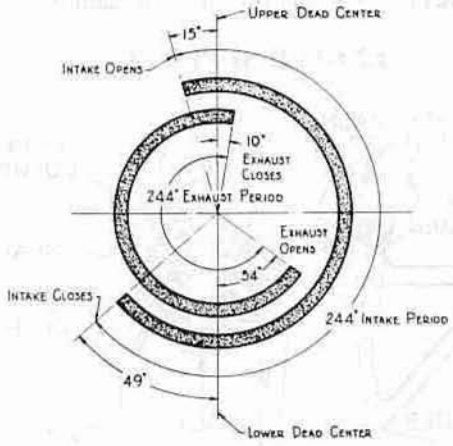
CAMSHAFT AND CAMSHAFT GEAR


CAMSHAFT GEAR
ALIGN TIMING MARKS WHEN INSTALLING TIMING GEARS
CRANKSHAFT GEAR
BACKLASH BETWEEN CRANKSHAFT GEAR AND CAMSHAFT GEAR TO BE FROM .001" TO .003"

ALL MODELS When installing timing gears, the timing marks must be aligned as shown. The camshaft gear is supplied in three sizes. Markings are "S" for standard, "H" for high limit and "L" for low limit. The crankshaft gear is available in the standard sizes only.

The timing gear backlash should be checked whenever gears are installed. If the backlash is in excess of .003" (0,076 mm) a larger camshaft gear should be installed.



Valve timing chart.

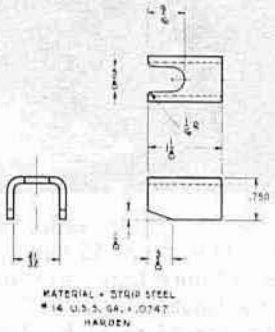
ALL MODELS To check the valve timing without dismantling the engine:

1. Adjust the tappet clearance of No. 1 intake valve to .020" (0,508 mm).
2. Turn the crankshaft until No. 6 cylinder is on the compression stroke and the IN OP (intake opening) is several inches before the pointer.
3. Move the tappet up and down, while slowly turning the crankshaft ahead, until no up and down clearance is felt.
4. This is the point at which No. 1 cylinder intake valve starts to open. If the timing is correct, the IN OP 1 and 6 marking should be directly under the pointer. The valve timing is incorrect if the flywheel marking is noticeably out of alignment with the pointer.

NOTE—On the Coupe Express and Standard models, the "IN OP 1 and 6" mark appears on the flywheel. On the Heavy Duty, the marking appears on the outer rim of the vibration damper.

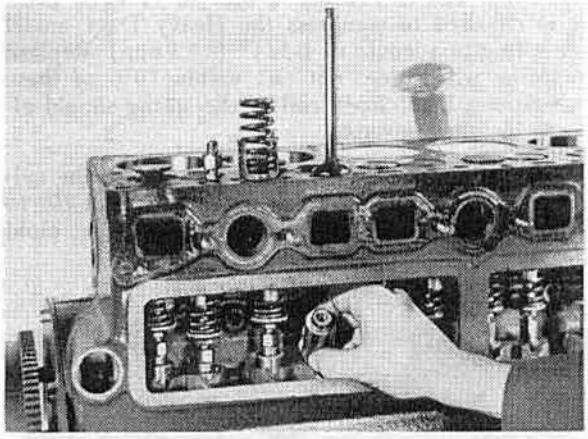
REMOVING CAMSHAFTS

ALL MODELS To remove the camshaft, it is necessary to remove the timing gear cover plate, raise the valve lifters off the camshaft, remove the two camshaft thrust plate retaining screws and pull the camshaft forward from the engine.

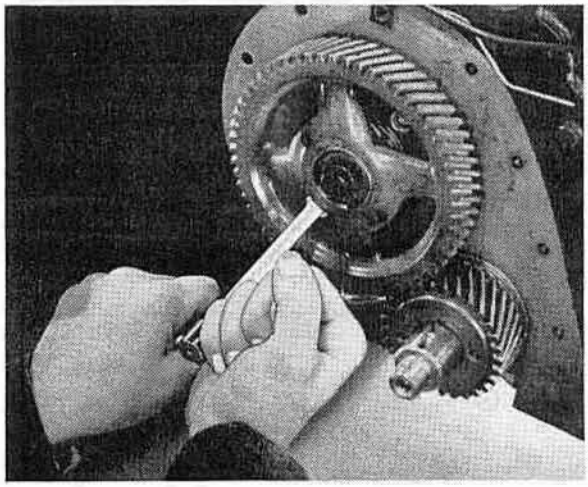


COUPE EXPRESS AND STANDARD Dimensions of valve lifter supports.

• Valve lifter supports can be used to hold the valve lifter off the camshaft while removing it.



HEAVY DUTY It is necessary to remove the valves and valve lifters on Heavy Duty models in order to remove the camshaft.



ALL MODELS Remove the camshaft thrust plate retaining screws. Then pull the camshaft and gear out toward the front.

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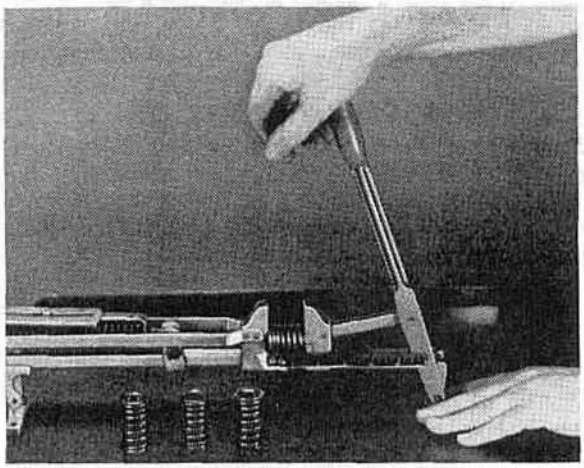
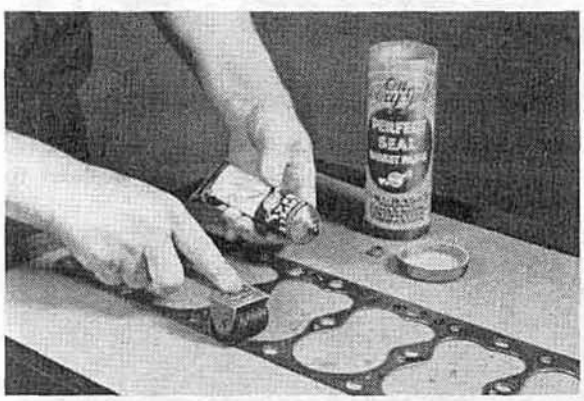
VALVES



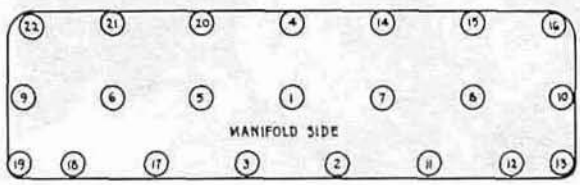
ALL MODELS Use Tool No. U-15 for testing valve springs. From 77 to 85 lbs. (34,92 to 38,55 kgs.) pressure is required to compress a Coupe Express or Standard engine valve spring to a length of 1-7/16" (36,5 mm). From 125 to 135 lbs. (46,43 to 51 kgs.) pressure is required to compress the Heavy Duty model valve spring to a length of 1-3/4" (44,5 mm). Replace any spring which does not test within 10% of these specifications. The closed coil of the spring should always be installed upwards.

ALL MODELS To recondition valve seats in the cylinder block, use a 45° angle stone on the seat, a 70° to 75° narrowing stone and a 30° facing stone. Hold width of seats to 3/32" (2,4 mm).

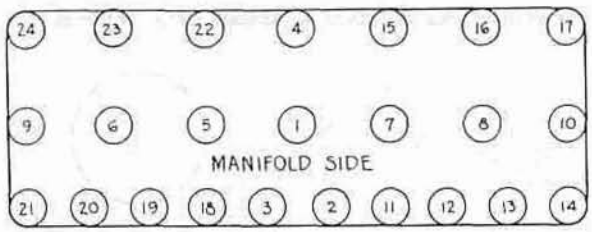
CYLINDER HEADS



ALL MODELS Always use Perfect Seal Gasket Cement on the finished surface of the cylinder head and on the cylinder block surface of the cylinder head gasket.



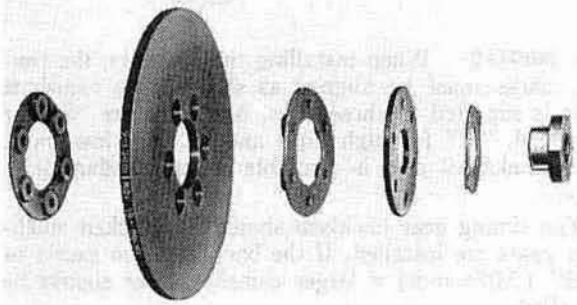
Tightening sequence — Coupe Express and Standard.



Tightening sequence — Heavy Duty.

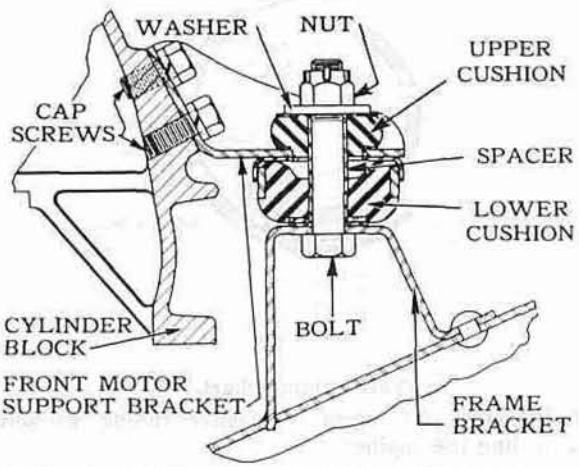
ALL MODELS Always tighten cylinder head screws with a tension wrench. A tension of 600 to 650 inch-pounds (69 to 75 M. Kgs.) is required on a Coupe Express or Standard engine and 1,000 inch-pounds (126,5 M. Kgs.) for the Heavy Duty engine.

VIBRATION DAMPER



HEAVY DUTY Parts of the vibration damper.

ENGINE SUPPORTS



ALL MODELS Coupe Express and Standard engines rest on a single bonded rubber mounting at the rear and two biscuit type rubber mountings at the front. Heavy Duty engines are mounted on rubber biscuit-type mountings at four points. Compression of the biscuit-type mountings used at front of all engines, and rear of the Heavy Duty engines, is regulated by a spacer. This spacer should not be shortened to increase compression of the biscuits.

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ENGINE DIAGNOSIS

ENGINE STARTS HARD OR WILL NOT START.

CAUSES

1. Improper carburetion due to:
   - A. Carburetor passages restricted by water, ice or corrosion.
   - B. Insufficient quantity or lack of gasoline in carburetor.
     1. Clogged or restricted fuel line from pump to carburetor.
     2. Clogged or dirty carburetor screen.
     3. Inoperative fuel pump.
     4. Low carburetor float level.
   - C. Air leaks at intake manifold or carburetor due to:
     1. Loose manifold and carburetor attaching nuts.
     2. Leaking intake manifold or carburetor gaskets.
     3. Leaks occurring in vacuum line connections at intake manifold.
     4. Warped carburetor manifold attaching flanges.
     5. Cracked intake manifold.
     6. Leak at air horn gasket or throttle shaft bearing.
   - D. Poor grade, old or stale fuel in combination with cold weather.
   - E. Cylinders and manifold flooded with gasoline.
2. Electrical Difficulties.
   - A. Battery.
     1. Battery low or completely discharged.
     2. Battery terminals loose or badly corroded.
     3. Improper ground from battery to frame or from frame to engine.
   - B. Ignition.
     1. Primary circuit.
        - a. High resistance due to corroded, dirty or loose connections.
        - b. Ignition out of time.
        - c. Weak or grounded condenser.
        - d. Distributor breaker points improperly spaced, dirty or loose.
        - e. Breaker arm sticking, springs weak or broken or arm grounded.
        - f. Loose or grounded distributor terminal posts.
     2. Secondary circuit.
        - a. Corroded cable terminals.
        - b. Chafed or cracked insulation on cables.
        - c. Ignition coil weak, improperly grounded or inoperative.
        - d. Moisture on ignition coil, terminals, distributor cover, spark plug porcelains, or in distributor.
        - e. Improper type of plug.
        - f. Cracked distributor cover.
        - g. Improper installation of secondary cables. (Not correct for engine firing order.)
        - h. Spark plugs damaged, dirty, wet, porcelains cracked or gap improperly spaced.
        - i. Rotor contact spring bent or broken.
        - j. Distributor rotor grounded.
        - k. Distributor cap center terminal (inner) broken or missing.
     3. Ignition switch.
        - a. Loose contacts.
        - b. Corroded or burnt contacts.
   - C. Starting Motor.
     1. Starting motor inoperative or not operating properly.
     2. Congealed engine oil due to the use of too heavy a grade of oil or to formation of sludge.
     3. Starting motor pinion stuck in flywheel gear.
     4. Starting switch not operating properly.
3. Poor Engine Compression resulting from:
   - A. Loose cylinder head cap screws.
   - B. Spark plugs loose in head.
   - C. Improperly installed or damaged cylinder head gasket.
   - D. Poorly seating valves.
   - E. Weak or broken valve springs.
   - F. Valves holding open due to insufficient tappet clearance.
   - G. Valves holding open due to stems being warped, corroded or gummed.
   - H. Badly worn, broken, weak or stuck piston rings.
4. Unusual Possibilities.
   - A. Valves improperly timed.
   - B. Broken or loose camshaft or distributor drive gear.
   - C. Cracked cylinder block.
   - D. Water in cylinders.
   - E. Excessive internal friction of engine assembly.
   - F. Broken or jammed internal parts of clutch or transmission.

UNEQUAL OR LOSS OF ENGINE COMPRESSION.

DESCRIPTION

Unequal compression between cylinders can often be detected by listening to the exhaust at the rear of the car when the car is standing and the engine running at a speed equivalent to a road speed of 15 and 20 miles per hour. Unequal compression will give an uneven exhaust. Items affecting ignition and carburetion should also be checked to definitely determine that a compression loss is occurring before any corrective measures are undertaken. A loss of compression in all cylinders can be generally detected by a decrease in power, speed and acceleration. It is important, however, that a compression gauge be used to accurately determine the compression before proceeding with corrective work.

TEST

A pressure gauge should be used in determining the compression pressures of the various cylinders. Remove the spark plugs and thread the pressure gauge into the spark plug hole of each cylinder. With the carburetor throttle open crank the engine by use of the starting motor and make a note of the maximum pressure indicated on the gauge. After the gauge readings have been taken for all cylinders the check may be repeated, if desired, by placing a teaspoonful of engine oil in the spark plug holes of all cylinders. If the pressure indicated on the gauge shows a decided increase, the difficulty is probably due to a compression loss past pistons and rings as the added oil is acting as a seal. If the pressure does not increase over the initial readings, improperly seating valves are at fault. A head gasket leakage between two cylinders will be indicated by a low pressure reading for the two adjacent cylinders.

A weak cylinder can also be detected by the sound of the starting motor, as the starting motor speed will increase when cranking against the weak cylinder.

CAUSES

1. Improperly Seating Valves.
   - A. Valves holding open due to insufficient tappet clearance.
   - B. Sticking valves.
     1. Insufficient stem to guide clearance.
     2. Gum or carbon deposits on valve stems and in valve guides.
   - C. Warped or broken valve heads or bent valve stems.
   - D. Burned, pitted or distorted valve seats.
   - E. Weak or broken valve springs.
2. Compression loss past pistons and rings.
   - A. Excessive clearance between pistons and cylinder walls.
   - B. Eccentric or tapered cylinder bores.
   - C. Scored cylinder walls.
   - D. Scored pistons or piston ring faces.
   - E. Insufficient piston ring end gap.
   - F. Piston rings stuck in ring grooves. (Gum or carbon deposit.)
   - G. Insufficient piston ring tension.

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H. Excessive clearance of rings in ring grooves. (Worn grooves or undersize rings.)

3. Cylinder head gasket leakage.
   A. Faulty head gasket.
   B. Loose cylinder head cap screws.
   C. Incorrect type of gasket.
   D. No gasket seal.
   E. Spark plug gasket leakage.
   F. Warped cylinder head.

LACK OF POWER OR HIGH SPEED PERFORMANCE.

DESCRIPTION

In attempting to diagnose and correct for lack of power or high speed performance the service man should first of all determine if the performance is normal and that the complaint is not "mental" on the part of the car owner. A comparison of the affected car with other cars of the same model will definitely determine this point.

TEST

The maximum acceleration and maximum speed should be checked with a stop watch over a definite distance. The service man should have an accurately measured course where maximum speed trials can be made without undue interference from other traffic. A general idea of the condition of the car can be obtained during the maximum speed test and definite checks should be made covering causes Nos. 3, 4, 7, 8, 11, 12, 14, 15, and 18.

The altitude at which a car is operated has a decided effect upon performance. A car adjusted for normal altitude will lack performance at the higher altitudes, while a car whose operation is entirely normal in the high altitudes may have a lean carburetor adjustment and show signs of pre-ignition when operated at sea-level.

CAUSES

1. Insufficient or unequal engine cylinder compression.
2. Improper ignition timing.
3. Inoperative automatic heat control valve. (Valve held in closed position.)
4. Improper carburetion.
5. Restricted carburetor air inlet resulting from:
   A. Dirty carburetor air cleaner.
   B. Restricted air passages in carburetor muffler.
   C. Choke valve not completely opening.
6. Improper adjustment of metering rod. See carburetor adjustment instructions.
7. Carburetor throttle lever loose on shaft.
8. Manual carburetor throttle linkage not properly adjusted and carburetor throttle valve not completely opening.
9. Improper fuel pump operation.
10. Partially restricted or clogged exhaust pipe, muffler or tail pipe.
11. Excessive engine temperatures.
12. Pre-ignition.
13. Excessive engine friction resulting from:
   A. Inadequate internal clearances. (Especially connecting rods.)
   B. Use of heavy engine oil.
   C. Use of piston inner rings.
14. Clutch slippage.
15. Excessive rolling resistance resulting from:
   A. Dragging brakes.
   B. Tight wheel, pinion, differential or transmission bearings.
   C. Misalignment in power transmitting units.
   D. Misalignment of rear axle.
   E. Under-inflated tires.
16. Use of too fast a rear axle gear or oversize tires.
17. Incorrect valve timing.
18. Inaccurate speedometer. (Gives impression of lack of performance.)
19. Vacuum spark modifier not operating properly.

ENGINE MISFIRES WHEN IDLING, NORMAL ENGINE TEMPERATURES.

CAUSES

1. Improper carburetion resulting from:
   A. Float level too high.
   B. Float level too low.
   C. Restricted or partially clogged idle air passage or jet.
   D. Air leak occurring between upper and lower carburetor body around idle tube.
   E. Air leak occurring around the carburetor throttle shaft.
2. Air leaks in intake manifold or carburetor resulting from:
   A. Loose manifold connections or leaks occurring in vacuum lines
   B. Loose manifold nuts.
   C. Broken or damaged intake manifold or carburetor gaskets.
   D. Crack in manifold.
   E. Warped or damaged manifold contacting surface.
3. Improper ignition.
4. Weak ignition coil.
5. Spark plug difficulties.
6. Uneven compression.
7. Heat control valve held open or weak control spring.
8. Unusual Causes:
   A. Slight water leaks occurring in the cylinder or combustion chamber.
   B. Slight leakage occurring at check valves in the fuel pump.
   C. Air leak occurring around the intake valve stem due to excessive valve stem to guide clearance.

ENGINE MISFIRES AT LOW SPEED (BELOW 20 M.P.H.) ON PULL.

CAUSES

Same causes as listed under Engine Misses When Idling — Normal Engine Temperatures.

ENGINE MISFIRES AT HIGH SPEEDS.

CAUSES

Please refer to Lack of Power or High Speed Performance, causes 1, 2, 3, 4, 5, 9, 10, 11, 12 and 17.

CRANKSHAFT KNOCKS.

DESCRIPTION

Noises classified as crankshaft knocks are usually dull, heavy, metallic knocks which either increase in frequency as the speed and load on the engine is increased, or are more noticeable at extremely low speed when the engine is idling unevenly.

TEST

The most common crankshaft knock — excessive bearing clearance — can usually be detected when the engine is pulling hard, at speeds above 35 M. P. H., or on acceleration and causes an audible "bump" with every explosion of the engine or when starting a cold engine after it has set over night. If excessive clearance exists at only one or two of the crankshaft journals, the "bump" will be less frequent and less pronounced. By alternately short circuiting each spark plug, the approximate location of the loose bearing can usually be determined. Causes 6, 7 and 8 can easily be confused with excessive clearance and should be checked before attempting any other corrections. Causes 3, 4 and 5 will cause a knock very similar to loose main bearings and it is usually impossible to accurately diagnose these causes without removing the crankshaft.

Excessive crankshaft end play causes a sharp noise or rap which occurs at irregular intervals, usually at idling speeds, and in bad cases can generally be detected by releasing and engaging the clutch. A loose flywheel can be detected by speeding the engine idle to an equivalent speed of 10 to 15 M. P. H. Turn off ignition switch until engine has almost stopped and then snap on ignition switch. If this operation is repeated several times, one distinct knock will be noted every time the switch is snapped on if the flywheel is loose.

A loose crankshaft gear can generally be detected by a sharp clatter at low engine speed with an uneven idle. When testing for either of these conditions it is well to short circuit one or two spark plugs to produce an extremely uneven idle.

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CAUSES

1. Excessive bearing clearance (radial)
2. Excessive end play.
3. Eccentric or out-of-round journals.
4. Sprung crankshaft.
5. Bearing misalignment.
6. Insufficient oil supply.
7. Low oil pressure.
8. Badly diluted oil (thin).
9. Loose flywheel.
10. Loose crankshaft gear.
11. Unusual Causes:
    A. Broken crankshaft web.
    B. Distorted crankcase.

CONNECTING ROD NOISES.

DESCRIPTION

Connecting rod noises are usually a light pound or knock of much less intensity than main bearing knocks. The noise is usually evident with the engine idling and becomes louder when the engine speed is slightly increased. On some engines connecting rod noise is most pronounced at a speed of approximately 30 M.P.H. when running with light engine load. Connecting rod noises should not be confused with Piston or Piston Pin Noises, as described in items 10 and 11.

TEST

Connecting rod noise can best be located by short circuiting the spark plugs. The noise can not generally be entirely eliminated by short circuiting, but will be considerably reduced. If causes 2, 3 and 4 are causing the noise, it may be impossible to reduce the noise to any extent by short circuiting; however, a slight change should be noted as each spark plug is shorted.

CAUSES

1. Excessive bearing clearance on crank pin (radial).
2. Insufficient oil supply.
3. Low oil pressure.
4. Badly diluted oil (thin).
5. Misaligned connecting rods.
6. Eccentric out-of-round, or tapered crank pin journal.

PISTON NOISES.

The most common piston noise is "slap", due to the piston rocking from side to side in the cylinder. Piston slap usually causes a hollow, muffled bell-like sound, although in some engines a clicking sound is heard. Slight piston noises that occur with a cold engine and disappear after the engine is warm, do not ordinarily warrant a correction. Piston ring noises generally cause a click, snap, or sharp rattle on acceleration.

TEST

Some piston and ring noises can be reduced by short circuiting the spark plugs; however, with other noises, this method is sometimes confusing. Piston slap can be more accurately detected by driving the engine at low speeds under load. The noise generally increases in intensity as the throttle is opened and additional load applied. On some engines with very loose pistons, a piston rattle is encountered at speed from 30 to 50 M. P. H. when the engine is not being accelerated.

Piston and ring noises can be momentarily eliminated by putting one to two ounces of very heavy engine oil into each cylinder through the spark plug hole. Crank the engine for several revolutions with the ignition off, until the oil has worked down past the piston rings. Replace the spark plugs, start the engine and determine if the noise still exists. If not, the noise is probably due to one of the following causes. As the engine operates for a short time the oil will get hot and run from the rings and pistons and the noise will reoccur.

CAUSES

1. Excessive piston to cylinder bore clearance.
2. Eccentric or tapered cylinders.
3. Insufficient piston pin clearance.
4. Connecting rod misalignment.
5. Piston or rings interfering with ridge at top of cylinder bore.
6. Piston interfering with carbon accumulation at top of cylinder bore.
7. Piston interfering with cylinder head gasket.
8. Collapsed piston skirts.
9. Broken piston rings.
10. Excessive vertical clearance of ring in ring groove.
11. Pin hole out-of-square with piston.
12. Ring lands not properly relieved.

PISTON PIN NOISES.

DESCRIPTION

The most common piston pin noise is the result of excessive piston pin clearance. This provides a sharp, metallic, double knock, generally audible with the engine idling and the spark fully advanced. On some engines, however, the noise is more noticeable at car speeds of 25 to 35 M. P. H. Interference between upper end of the connecting rod and pin boss is difficult to diagnose and can be mistaken for a loud valve tappet noise.

TEST

Allow the engine to run at idle speed with the spark fully advanced. In most cases, a sharp, metallic, double knock will be noted when the spark plugs are short circuited in the cylinder with loose piston pin. The knock will become more audible when the spark plug is shorted. Retarding the spark will generally reduce the intensity of the knock. If the pins in all cylinders are loose, a metallic rattle will be heard which is impossible to short out in any one cylinder.

As piston, piston pin, and connecting rod noises are easily confused, it is suggested that the piston and connecting rod be removed and a bench test be made by feeling for piston pin looseness before actual corrective work is undertaken.

CAUSES

1. Excessive piston pin clearance.
2. Loose piston pin locking pin.
3. Piston pin loose in upper end of connecting rod.
4. Piston pin rubbing cylinder wall.
5. Connecting rod end rubbing piston pin boss.
6. Insufficient piston pin clearance. (Causes piston slap.)

VALVE AND VALVE LIFTER (PUSH ROD) NOISES.

DESCRIPTION

Noisy valve action has a characteristic clicking noise occurring usually at regular intervals. The frequency of valve action noise is generally less than other engine noises, inasmuch as the valves are operated by the camshaft running at one-half engine or crankshaft speed. If one or two of the valves or valve lifters are causing the noise, the clicking sound will be intermittent; however, if the difficulty occurs with the majority of the valves, the noise may be continuous and will increase in intensity as the engine speed is increased.

TEST

The common cause of valve action noise is that of excessive valve stem to tappet clearance. To check, insert a thickness gauge between the bottom of the valve stem and the tappet adjusting screw with the engine idling. If the clicking noise ceases, the clearance is probably excessive and the adjusting screw should be readjusted. It is important, however, that this clearance not be reduced below factory specifications for the various models, otherwise burned valves are likely to result.

If readjustment of the valve stem to tappet clearance does not eliminate the noise, the condition and clearances of all parts of the valve action should be checked as outlined in the following causes.

CAUSES

1. Common Causes.
    A. Excessive valve stem to tappet clearance.
    B. Excessive clearance of push rod in guide.
    C. Push rod (lower end) scored, chipped, rough, worn or broken.
    D. Push rod adjustment screws.
        1. Face worn.
        2. Face not properly machined.
        3. Threads stripped or crossed.
    E. Weak valve springs.

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2. Uncommon Causes.
   A. Excessive valve stem to guide clearance.
   B. Insufficient valve stem to guide clearance.
   C. Warped valve head.
   D. Valve head face that is not concentric with stem axis.
   E. Valve seat face that is not concentric with stem axis.
   F. Very rough surface on cams.

SPARK KNOCK (PRE-IGNITION OR DETONATION).

DESCRIPTION

Spark Knock and Pre-ignition or Detonation causes a metallic ringing sound which is often described as a "ping" as is usually encountered when the engine is laboring, accelerating rapidly or overheated.

TEST

Drive the car until the engine temperatures have become normal, then rapidly accelerate in high gear. If a spark knock is present, a "pinging" sound will be heard during at least a portion of the accelerating period. The intensity of the "ping" can be increased by covering the radiator and causing the engine to labor at excessive engine temperatures.

CAUSES

1. Large carbon deposits in combustion chamber.
2. Ignition timed too early.
3. Faulty automatic distributor advance (weak springs.)
4. Inoperative spark advance modifier.
5. Spark plugs.
   A. Incorrect type of plug. (Using a plug which is too hot.)
   B. Porcelains or electrodes carbonized or burned.
6. Sharp metallic edges in combustion chamber.
7. Cylinder head gasket projecting in combustion chamber.
8. Hot engine valves resulting from:
   A. Incorrect width of valve seats.
   B. Insufficient tappet clearance.
   C. Use of wrong type of valve.
   D. Thin edged valves.
9. Excessive engine temperatures.
10. Poor grade of fuel.
11. Old or stale fuel.
12. Excessively lean carburetor mixture.
13. Inoperative automatic heat control valve. (Valve held in closed position.)

ENGINE BACK FIRING THROUGH CARBURETOR.

DESCRIPTION

Engine back firing through the carburetor when starting a cold engine is many times unavoidable and should not be considered, as it is the result of the incorrect air-gasoline mixture entering the engine and will automatically correct itself after the engine reaches normal operating temperatures if carburetor and choke adjustments are correct. Continued back firing after the engine has become warm or back firing after considerable operation should be corrected by checking the following causes:

CAUSES

1. Improper ignition timing.
2. Improperly seating valves, especially intake.
3. Incorrect valve timing.
4. Pre-ignition from any source.
5. Excessively lean or abnormally rich carburetor mixture.
6. Intake manifold air leaks.
7. Defective cylinder head gasket. (Especially between cylinders.)
8. Poor quality of fuel.
9. Secondary wires improperly installed (crossed) in distributor cap.
10. Distributor governor sticking.

MISCELLANEOUS ENGINE NOISES.

DESCRIPTION

Miscellaneous engine noises are sometimes very difficult to find and it is impossible to accurately describe and suggest methods for locating all of the noises which may occur. The following causes are those most frequently encountered. Cause Nos. 1, 2, 3 and 4 usually cause a heavy thud while a manifold heater valve rattle is apparent as a light metallic rattle or vibration. No. 7 causes roaring noise when the engine is running. No. 9 causes a whistle at all engine speeds while a similar whistle is encountered from No. 12 when the engine is accelerated. No. 11 causes squeaks and rattles.

FREQUENT CAUSES

1. Engine loose in frame.
2. Engine supports loose (rear bracket and front cross member.)
3. Engine supports at front of cylinder block loose or broken.
4. Flywheel loose on crankshaft.
5. Crankshaft fan pulley loose on crankshaft.
6. Manifold heat control valve rattling.
7. Thin walled manifold (roaring noise).
8. Foreign object in exhaust manifold or passages.
9. Loose exhaust pipe at manifold connections.
10. Interference of exhaust line with frame.
11. Exhaust to inlet manifold gaskets blown.
12. Engine striking dash.
13. Transmission rubbing floor boards.
14. Loose engine accessories such as generator, water pump, engine fan, horn, etc.
15. Excessive timing gear back lash (sharp rap occurs).

ENGINE TORSIONAL VIBRATION.

DESCRIPTION

Torsional vibration is more severe in some engines than in others due to unavoidable manufacturing tolerances. Torsional vibration is generally apparent as a high pitched whir at definite speed ranges. Torsional vibration will not be apparent through the entire engine speed range but may be apparent at a definite speed within a range of three or four M. P. H. A slight torsional vibration may be normal and the service man should not attempt a correction unless the vibration becomes severe.

CAUSES

1. Excessive timing gear lash (.003" or more).
2. Eccentric timing gear (usually result of high key).
3. Timing gears loose on cam or crankshaft.
4. Excessive clearance at camshaft forward bearing.
5. Excessive clearance at crankshaft forward bearing.
6. Engine slightly loose in mountings.
7. Clutch linkage cross shaft not free or lubricated properly.

ENGINE VIBRATION — ESPECIALLY HIGH SPEED.

CAUSES

1. Unequal compression of engine cylinders.
2. Ignition distributor points not synchronized.
3. Engine misfires at high speeds.
4. Unbalanced fan or loose fan blade.
5. Incorrect adjustment of biscuit type engine mounting.
6. Loose engine mountings.
7. Engine support loose on frame or cylinder block.
8. Unbalanced or sprung crankshaft.
9. Excessive engine frictional resistance resulting from:
   A. Insufficient internal clearances.
   B. Scored pistons.

EXCESSIVE ENGINE OIL CONSUMPTION.

DESCRIPTION

Speed and the general condition of the engine has a decided effect upon oil consumption. It must be remembered that sustained high road speeds require greater oil consumption to provide adequate lubrication than do moderate speeds in city driving. It must also be remembered that the modern engine holds from a pint to a quart of oil in suspension for from 5 to 10 minutes after stopping the engine. For this reason an accurate check of the oil level can not be obtained until after the engine has been stopped and allowed to stand for several minutes with the car sitting level. If the engine is actually burning excessive oil, it will be indicated by gray smoke emerging from the exhaust pipe whenever the engine is accelerated after running at idle speed for a short period of time.

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TEST

Before any corrections for oil consumption are made, a test drive of 50 or 100 miles should be made with oil known not to be excessively diluted and of a known viscosity. This test should be made at the average speed at which the car owner usually drives. Before the test is started, the engine should be operated for a sufficient length of time to reach normal operating temperatures; the oil allowed to drain for 10 minutes and the quantity carefully measured and sufficient oil added to the container so that the oil pan may be refilled with the factory recommended amount. After the test has been run, the oil should be drained as soon as possible and the car allowed to stand for 10 minutes before the quantity of oil drained out is measured.

If excessive oil consumption is encountered, a very careful check for leaks should be made before the engine is disassembled. A check for leaks can be made by spreading papers on the floor of the garage under the forward part of the car and running the engine idle for several minutes at an equivalent speed of from 20 to 25 M. P. H. A severe leak will be apparent by oil dropping on the paper.

CAUSES

1. Loss from external leaks:—
   - A. Oil pan gasket damaged or improperly installed.
   - B. Oil pan gasket flange distorted or cap screws loose.
   - C. Oil pan drain plug loose or gasket damaged.
   - D. Oil pan cracked.
   - E. Rear main bearing cap oil seal plugs improperly installed or loose.
   - F. Timing gear cover or plate gasket damaged or improperly installed.
   - G. Timing gear cover flange distorted or cap screws loose.
   - H. Timing gear cover cracked.
   - I. Valve cover plate gasket damaged or improperly installed.
   - J. Valve cover plate gasket surface dirty, distorted or plates loose.
   - K. Breather housing or housing tube stud loose.
   - L. Oil pump cover gasket loose or improperly installed.
   - M. Loose fuel pump gasket.
   - N. Crankshaft fan pulley due to:
     1. Eccentric pulley hub.
     2. Timing gear cover not properly centered on pulley hub.
     3. Rough pulley hub.
     4. Restricted or absence of oil return groove on pulley hub.
     5. Failure to properly install nut washer or gasket at front end of crankshaft.
   - O. Camshaft rear bearing Welsh plug loose or improperly installed.
   - P. Leaks at oil filter lines.
   - Q. Leaks at flexible oil gauge pipe connector.
2. Poor quality or improper viscosity of engine oil.
3. Badly diluted engine oil.
4. More than recommended amount of oil in engine pan.
5. Excessive oil pressure.
6. Sustained high road speeds. (Requires greater oil consumption for adequate lubrication.)
7. Abnormal piston to cylinder wall clearance or scuffed pistons.
8. Eccentric or tapered cylinder bores.
9. Piston ring difficulties.
   - A. Badly worn or scuffed piston rings.
   - B. Broken piston rings.
   - C. Piston rings stuck in ring grooves. (Gum or carbon deposit.)
   - D. Improper piston ring combination.
   - E. Piston rings loose in ring grooves.
   - F. Insufficient end gap clearance of rings.
   - G. Insufficient ring tension.
10. Excessive radial or axial clearance of main or connecting rod bearings or out-of-round crankshaft journals.
11. Abnormally high crankcase temperatures.
12. Distortion of cylinder block due to uneven tightening of cylinder head bolts.
13. Excessive clearance between intake valve stems and guides.

OIL PRESSURE — ENGINE.

DESCRIPTION

The engine oil pressure gauge should register from 20 to 40 lbs. at 40 M. P. H. with warm oil.

CAUSES

1. Low oil pressure.
   - A. Use of very light or badly diluted engine oil.
   - B. Water, sludge, ice or dirt restricting oil pump intake screen.
   - C. Oil relief valve not properly seating due to:
     1. Foreign substance on valve seat or valve face.
     2. Weak or broken valve spring.
   - D. Air leaks occurring in oil pump suction line.
   - E. Loose oil pump body, cover or improperly installed gaskets.
   - F. Badly worn or damaged oil pump gears.
   - G. Excessive clearance of pump gears in pump body.
   - H. Pressure loss in the distributing line due to:
     1. Improperly installed or loose gaskets.
     2. Fractured tubes, pipes, webs or loose connections.
   - I. Excessive clearance of main, connecting rod or camshaft bearings.
   - J. Inaccurate oil pressure gauge.
   - K. Excessive clearances at valve pushers.
2. High oil pressure.
   - A. Use of heavy engine oil.
   - B. Relief valve not opening due to:
     1. Heavy or stiff relief valve spring.
     2. Relief valve stuck.
   - C. Restricted or partially clogged distributing line or oil passage at relief valve.
   - D. Inaccurate oil pressure gauge.

INOPERATIVE ENGINE OIL FILTER — SPECIAL EQUIPMENT.

CAUSES

1. Filter inlet or outlet psasages or pipes clogged or restricted.
2. Filter inlet or outlet passages, pipes or connections leaking.
3. Filter body clogged and should be changed.

OIL PUMP AND DISTRIBUTOR DRIVE NOISES.

DESCRIPTION

Oil pump and distributor drive noises are usually encountered when the engine is idling. A grind or growl usually indicates causes Nos. 1 and 2 while a whine indicates causes Nos. 3 and 9. A chatter usually accompanies causes 4 to 7 inclusive, while a fairly heavy bump indicates a loose pump mounting. Hydraulic rap is similar to a main bearing knock and increases in frequency as the engine speed is increased.

TEST

Causes 1 to 9 inclusive can generally be located without disassembling any parts with the use of a sounding rod in the region of the oil pump and distributor. Cause No. 10 can be diagnosed by firmly gripping the oil pressure gauge with the hand and noting if pulsation or bump is apparent.

CAUSES

1. Worn or damaged oil pump and distributor driven gear.
2. Worn or damaged camshaft drive gear.
3. Improper mesh of drive and driven gears.
4. Couplings loose on shaft.
5. Excessive clearance of shaft in oil pump body or distributor bracket bushings.
6. End play in distributor drive shaft.
7. End play in oil pump drive shaft.
8. Oil pump not rigidly mounted.
9. Damaged or scuffed oil pump gears.
10. Oil pump hydraulic rap.

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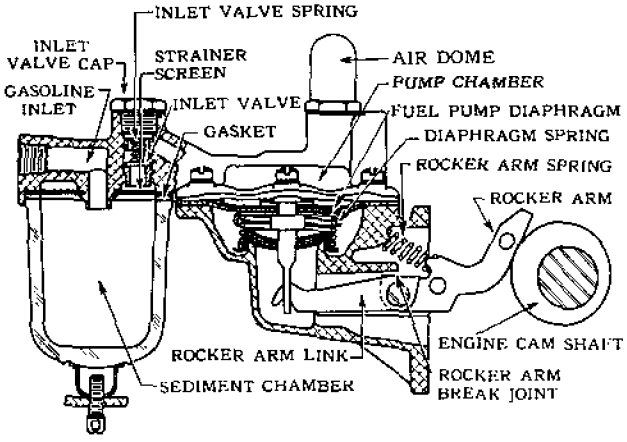
GASOLINE SECTION

SPECIFICATIONS

		Coupe Express & Standard	Heavy Duty
Gasoline tank capacity	U. S. Gallons	18	18
	Imp. Gallons	15	15
	Liters	68	68
Carburetor model		WA 1-496 S	BBR 1-428 S
Carburetor size		1-1/4" (31,75 mm)	1-1/4" (31,75 mm)
Set idle adjusting screw		1 to 2 turns out	1/4 to 3/4 turn out
For richer mixture		Turn screw out	Turn screw out
Air cleaner type		Dry	Dry
Choke		Automatic	Manual
Heat type adjustment		Automatic	Automatic

SERVICE TOOLS — GASOLINE

J-505-SBT	Combination Carburetor Tool Kit
907	Fuel Pump and Engine Vacuum Tester
J-750-SA	Gasoline Mileage Tester



FUEL PUMPS

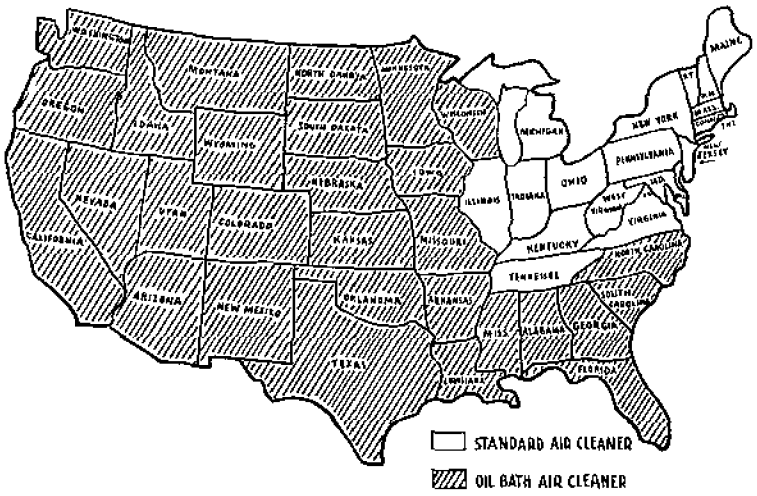
ALL MODELS The sediment bowl should be removed and cleaned periodically. When installing the sediment bowl, make sure the gasket is in good condition. Fuel pump pressure should be checked every 10,000 miles (16.090 km) or whenever unsatisfactory fuel economy is reported, with gauge No. 907 connected between the carburetor and the fuel pump line. (Correct pressure 2 to 4 lbs.) (0,907 to 1,81 kgs.)

Revised December, 1941

CARBURETOR AIR CLEANER

• The clear spaces show the localities where the standard type cleaners are used; crosshatched spaces show wet types.

NOTE—Wet type air cleaners are installed on all units going into Wisconsin, all territory west of the Mississippi River, and all States south of Virginia and Tennessee. REGARDLESS OF THE LOCALITY, WET TYPE AIR CLEANERS SHOULD ALWAYS BE USED WHERE CONCENTRATED DUST CONDITIONS PREVAIL.



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ALL MODELS The standard (oil coated) type air cleaner should be serviced as frequently as operating conditions dictate, and never to exceed 1,000 mile (1.609 Km.) intervals. The following operations are necessary in servicing the standard air cleaner:

1. Remove the element.
2. Wash the element in gasoline and blow it out with compressed air.
3. Submerge the element in a good grade of engine oil and allow the excess oil to drain off before reinstalling the element in the cleaner.

• Wet (Oil Bath) Type.

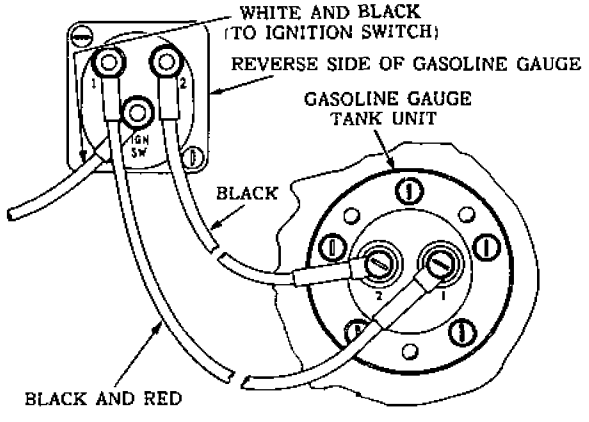
The wet (oil bath) type cleaners should be serviced every 1,000 miles (1.609 km.), or daily, if dust conditions are severe. The following are the necessary servicing operations:

1. Remove the filtering element, wash it in gasoline and allow it to dry thoroughly.
2. Clean the oil reservoir.
3. Pour one pint of engine oil (S. A. E. No. 50 for summer and a lighter oil for winter) into the reservoir. Do not use an oil lighter than S. A. E. No. 20 for winter.
4. Reassemble cleaner.

The combination oil level gauge and oil filler cap is equipped with an air filtering element. The element should be serviced in the same manner as the standard type air cleaner previously described. Service the oil filler cap whenever the air cleaner is serviced.

Air cleaners should be checked on every car that is brought into the service department, even though the owner does not request it. Very little time is required to perform these important service operations; therefore, it is suggested that this service be performed whenever the motor is tuned or the car lubricated. Carry an adequate supply of oil bath type air cleaners in stock for ready use when needed.

GASOLINE GAUGE



ALL MODELS To check the electric gasoline gauge:

1. Use a tank unit known to be in good condition.
2. Disconnect the wires (black and black and red) from terminals No. 1 and No. 2 on the gauge unit.
3. Using short wires, connect the spare tank unit. Be sure to connect a ground wire from the spare tank unit to the frame.
4. Turn on the ignition switch. Check the action of the gauge unit while moving the tank unit float arm by hand. Allow about one minute for the gauge to read true.
5. If the gauge readings are correct, the trouble is with the car tank unit or the wiring.

ALL MODELS To check the wiring:

1. Insert a 6-volt test light in series between the tank unit and the wiring to the gauge unit.
2. With the ignition turned on, the lamp should go on and off at regular intervals, indicating satisfactory wiring. If the lamp does not light, this indicates a ground or an open circuit in the wiring. This test should be made on both wires.

A fluctuating gauge needle indicates dirty contact points. Remedy this by drawing a clean paper between the points. When attaching the wires, do not draw up the nuts too tightly on the gauge unit, because it loosens the studs and destroys the accuracy of the gauge, making replacement necessary. When the gauge unit is removed from the car for checking, be sure to shield it from air currents which might cause uneven cooling of the bi-metal.

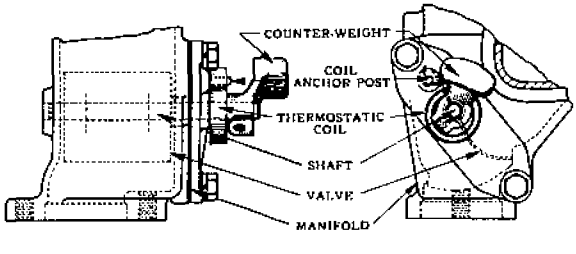
GAUGE READINGS

Tank Condition	Black Wire Grounded	Black and Red Wire Grounded
Empty	Empty	1/2 Full
1/2 Full	1/2 Full	3/4 Full
Full	1/4 Full	Full

GAUGE READINGS

Tank Condition	Black Wire Open	Black and Red Wire Open
Empty	1/2 Full	Empty
1/2 Full	Full	Empty
Full	Full	Empty

MANIFOLDS



Coupe Express and Standard.

ALL MODELS The correct amount of heat for the gasoline-air mixture entering the cylinders is provided by a thermostatically controlled inlet manifold heat control valve. To test the thermostatic coil tension, unhook the coil from the pin. With the thermostat valve in closed position (counterweight up), the hook in the end of the coil should assume approximately 90° at 70° F. (21° C.) temperature of coil. Install a new coil if the angle is incorrect.

A sticking heater valve affects engine performance adversely. Loosen the shaft with a mixture of kero-

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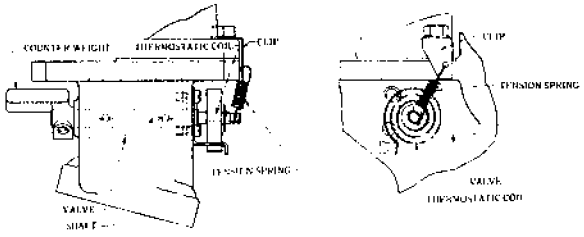
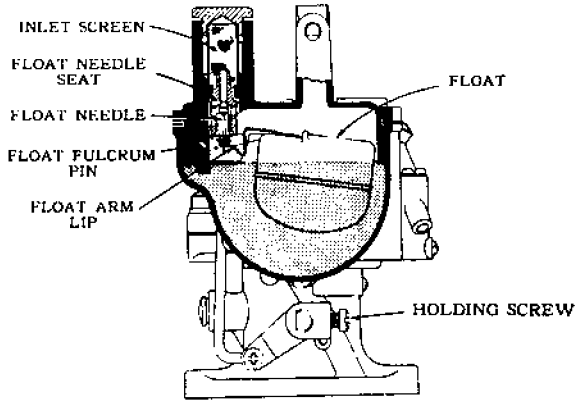


Heavy Duty.

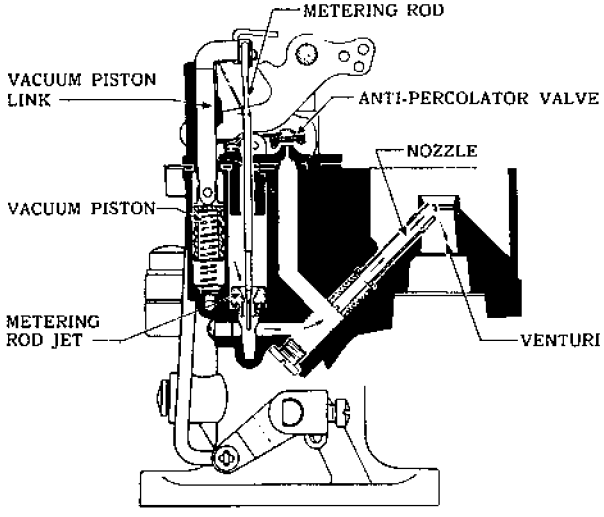
sene and soda. Then remove the shaft and reduce the diameter to give .005" (0,127 mm) clearance. Do not disturb the shaft bore in the manifold because a protective scale has been deposited and it will merely form again if the scale is removed.

CARBURETORS

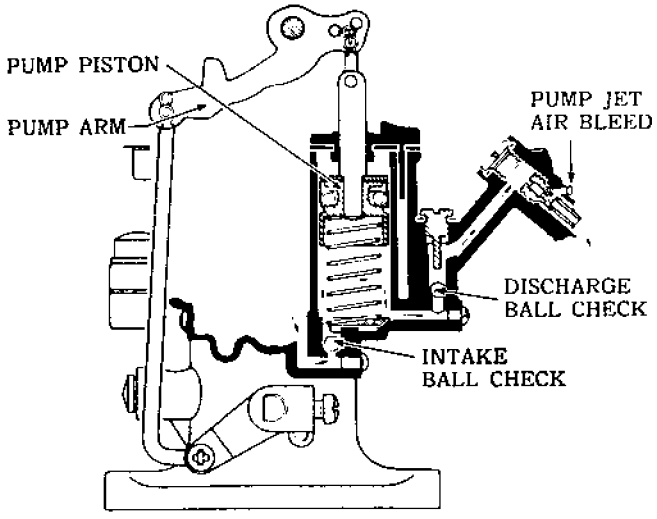
COUPE EXPRESS AND STANDARD The carburetor used on the Coupe Express and Standard models is the Carter WA-1 downdraft type using an automatic choke, accelerating pump, vacuum economizer and anti-percolator valve.



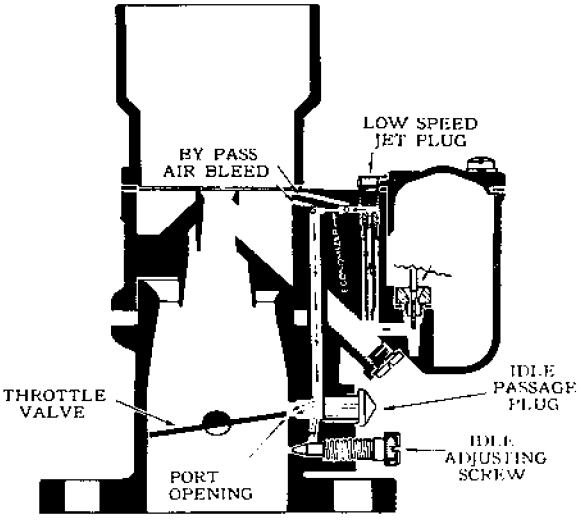
• Gasoline enters the float bowl through the inlet screen past the needle valve. The needle valve is controlled by the float and the height of the fuel level in the float bowl.



• The arrows indicate the passage of fuel through the carburetor and the main metering system.



• The arrows indicate the passage of fuel through the carburetor when using the accelerating pump.



• Arrows indicate the direction of the flow of fuel through the parts and passages of the low speed circuit.

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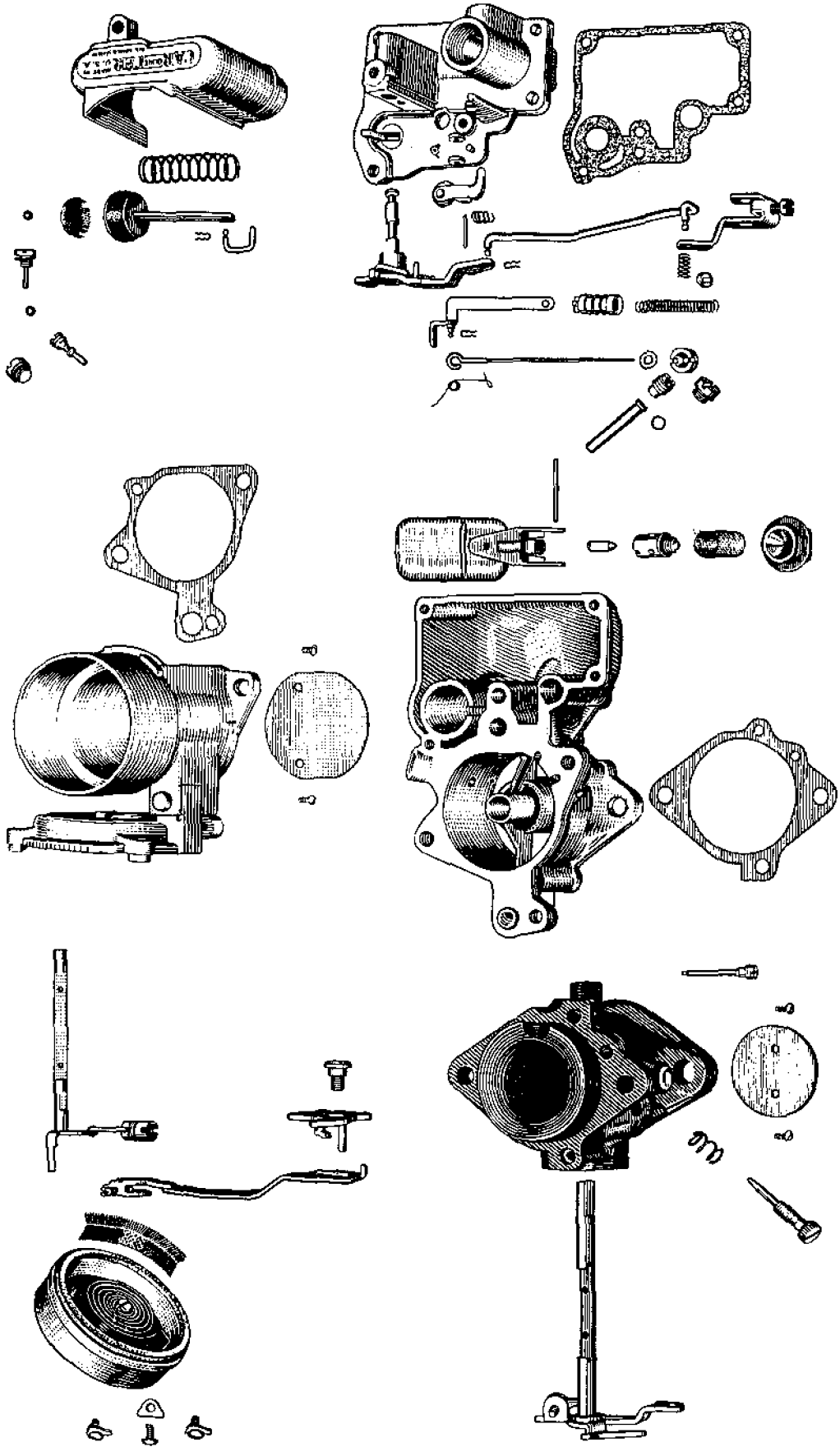

Coupe Express and Standard carburetor parts in their order of assembly.

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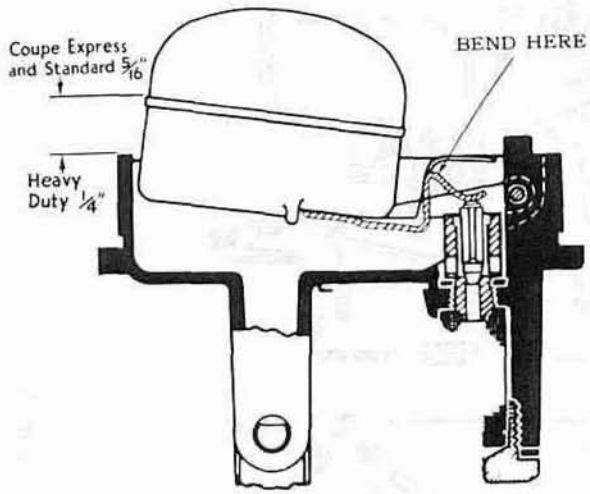
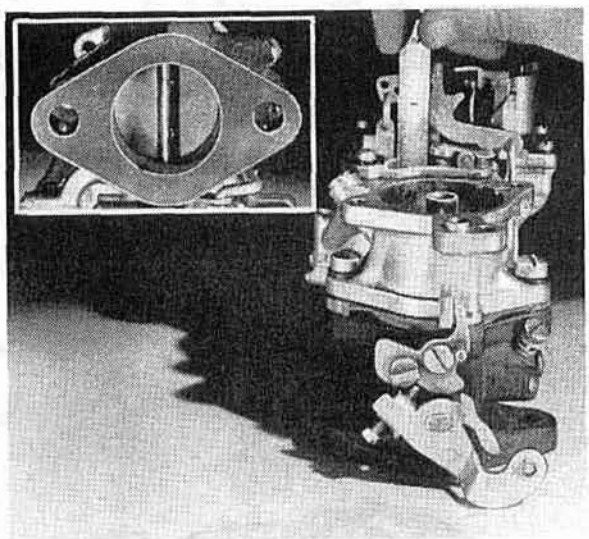
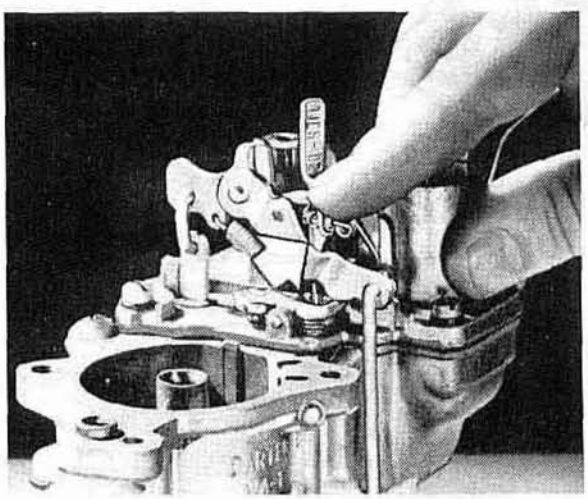


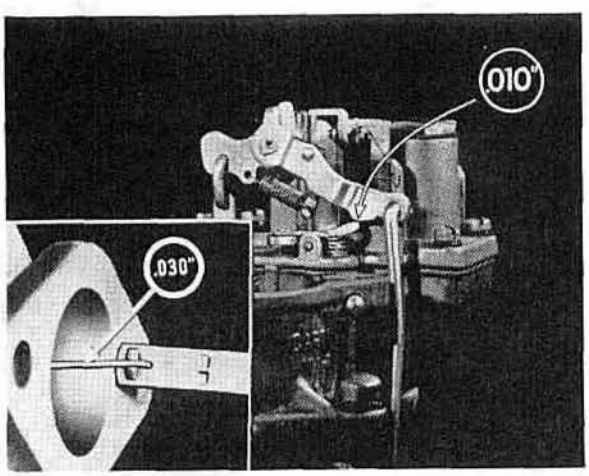
FLOAT. Use float gauge No. T-109-107 to check the float level. With the float cover turned upside down, allowing the weight of the float to be supported by the float arm resting on the needle valve, the distance between the boss on the float cover and the far edge of the float seam should be 5/16" (8,0 mm). The adjustment is made by bending the lip on the float arm. Do not bend the float.



PUMP. To check the travel of the accelerating pump piston, back off the idle speed adjusting screw to a fully closed throttle position. Set the throttle at wide open position and mark the pump piston rod at the level of the boss on the float cover. Then close the throttle and measure the height of the mark on the pump piston rod above the boss. This distance should be 11/64" (4,36 mm). If the height of the mark on the rod is incorrect, adjust by bending the throttle connector rod with Tool No. T-109-41.



METERING ROD. The idle adjusting screw must also be backed off to set the metering rod. Insert the metering rod gauge No. T-109-102 in place of the metering rod, seating the tapered end in the jet. With the throttle valve closed, press down lightly on the piston link directly over the piston. There should be less than .005" (0,127 mm) clearance between the metering rod pin and the shoulder of the notch in the gauge. The gauge must not drag on the pin. The adjustment can be made by bending the lip on the metering rod carrier.



PERCOLATOR VALVE. To check the seating of the percolator valve, insert a .030" (0,76 mm) wire or drill in the throttle body opposite the idle port. With the throttle closed on the wire, or drill, the clearance between the percolator valve arm and the pump arm should be .010" (0,254 mm). Clearance should be adjusted by bending the percolator valve arm.

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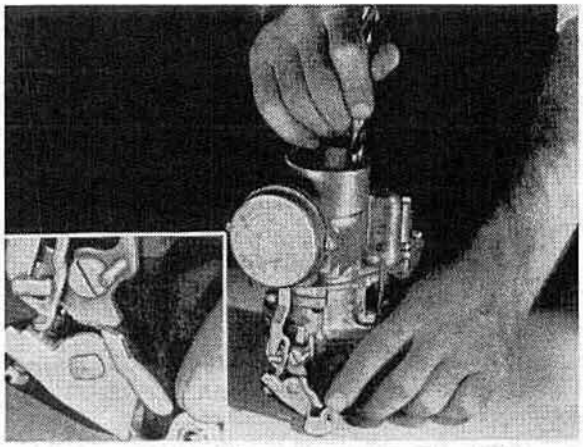
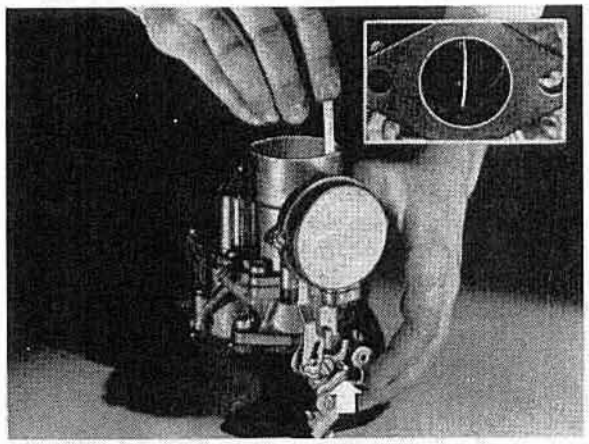
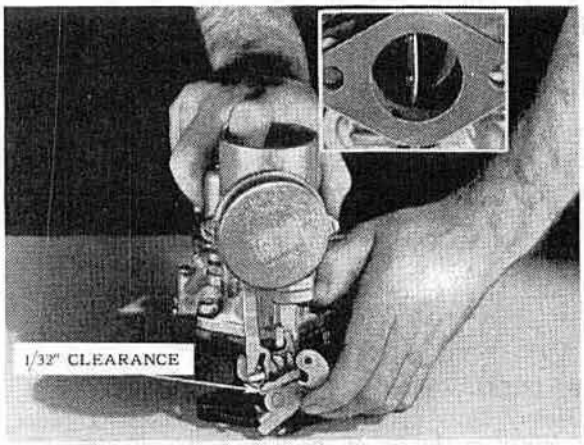


IDLE. The first step in checking the fast idle is to set the idle speed adjusting screw on the lower step of the fast idle cam. With the throttle valve and choke connector link in this position, the lower side of the choke valve should just touch a 5/8″ (15,9 mm) drill inserted between the choke valve and the air horn.



WIDE OPEN THROTTLE KICK. To check the wide open throttle kick, open the throttle valve to the wide open position. There should be 1/4″ (6,4 mm) clearance between the low side of the choke valve and the inside of the air horn. To measure the clearance, insert a 1/4″ (6,4 mm) drill or gauge in the air horn. To adjust — bend the kick-off arm on the throttle lever.



WIDE OPEN CHOKE LOCK. With the throttle wide open, there should be 1/32″ (0,8 mm) clearance between the lip on the throttle lever and the lip on the fast idle connector link when the choke valve is wide open. The lock must prevent the choke from closing and there must be no bind in the mechanism.

CHOKE. To adjust the automatic choke, loosen the three cover retaining screws and turn the cover clockwise or counter-clockwise. In production the notch on the cover and the center mark on the back plate are lined up. For unusual weather conditions or variations in fuel octane ratings, the cover can be rotated counter-clockwise for a richer mixture, and clockwise for a leaner mixture. Do not turn the cover more than one notch per adjustment.

CARBURETOR REASSEMBLY.

1. Thoroughly clean the casting and all parts (except cork pieces, coil and housing assembly) in gasoline.

2. Install the strainer, strainer nut and gasket assembly. Use a new gasket.

3. Install the needle seat and gasket assembly. Check for wear. If either the needle or seat shows wear, replace both.

4. Install the needle, float and lever assembly and the float lever pin. Check the float and float pin for wear and the float for dents. Check the bowl cover for wear in the countershaft hole. Set the float level to specifications — bend the lip, not the float.

5. Back out the throttle lever adjusting screw before installing the throttle shaft and lever assembly and throttle valve. The small "c" in the circle should

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be toward the idle port facing the manifold side of the flange. Center the valve by tapping it lightly before tightening the screws. Use new screws.

6. Install the idle port rivet plug.

7. Install the idle adjusting screw and spring. Back out from the seated position to specifications.

8. Assemble the body and body flange gasket assembly. Use a new gasket. Pull the screws down evenly and do not forget the lock washers.

9. Install the low speed jet assembly. See that the jet seats firmly in the casting.

10. Install the pump jet, pump jet passage plug and gasket assembly. Use a new gasket on the passage plug.

11. Install the pump check ball and pump discharge ball retainer and gasket. Use a new gasket.

12. Install the pump intake check ball and pump strainer assembly. Examine the leather for damage and if it is not in good condition, replace the entire assembly.

13. Install the metering rod jet and gasket assembly. Inspect it for wear. If the jet is worn, replace both the rod and jet, using a new gasket.

14. Install the pump arm and countershaft assembly. Place the connector link on the pump shaft and in the proper hole in the pump arm.

15. Install the bowl cover assembly. Use new gaskets. Install the idle passage plug and gasket assembly.

16. Install the anti-percolator cap, rocker arm assembly and spring. Be sure the leather is in good condition and the pin is not worn.

17. Install the vacuum economizer piston and metering rod assembly.

18. Install the throttle shaft arm, screw assembly and throttle connector rod. Check the arm for wear.

19. Adjust the pump stroke, with the throttle connector arm in place.

20. Adjust the metering rod after the pump adjustment is made.

21. Adjust the anti-percolator.

22. Install the nozzle, nozzle retainer plug, nozzle passage plug and gasket assembly. Use new gaskets.

23. Install the air horn and piston housing assembly. Tighten the screws evenly, use a new gasket and do not forget the lock washers.

24. Install the choke shaft and piston assembly, with the choke lever, screw and link assembly in place. Check for a loose lever on the shaft.

25. Install the choke valve. Use new screws. Center the choke valve by tapping lightly. Hold it in place with the finger while tightening the screws.

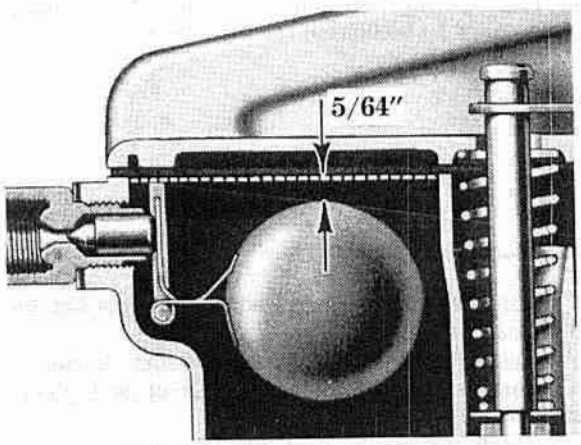
26. Install the piston housing strainer, thermostatic coil and housing assembly. Have the housing assembly indicator marks at the bottom. Then revolve the housing counter-clockwise and set it as specified.

27. Hold the choke valve wide open and tighten the choke lever screw. Be sure the linkage does not bind in any position. Fast idle, unloader and lockout adjustments must be made as specified.

28. Install the fast idle cam and pin assembly. Install the carburetor.

HEAVY DUTY CARBURETORS

HEAVY DUTY The carburetor used on the Heavy Duty model is a Carter model BBR of the downdraft type. This carburetor is easy to service because of its simple construction. Parts of the carburetor are shown in their order of assembly on page 29. The following are the only adjustments necessary.



HEAVY DUTY — FLOAT. If after considerable service, the Heavy Duty carburetor loads up, check the float level. Wear on the lip of the float lever will raise the float level. Be sure the float lever pin is firmly seated. To raise the level, bend the lip of the float lever away from the needle; bend the lip toward the needle to lower the float level. (Bend only the vertical lip of the float.) Adjust the float level so that the top of the float is 5/64" (1,98 mm) below the rim of the float bowl.

ACCELERATING PUMP. If acceleration is unsatisfactory, remove the pump jet and clean it with compressed air. Poor acceleration may also be due to: damaged or worn plunger leather in the accelerating pump; sediment in the pump cylinder; or a clogged intake ball check at the bottom of the pump cylinder. If the plunger is removed from the cylinder use care when installing it to avoid damaging the plunger leather.

Tool No. T-109-42 is needed for removal of the rivet plug beneath the float bowl. A new tube can be inserted with Tool No. T-109-70.

Revised December, 1911

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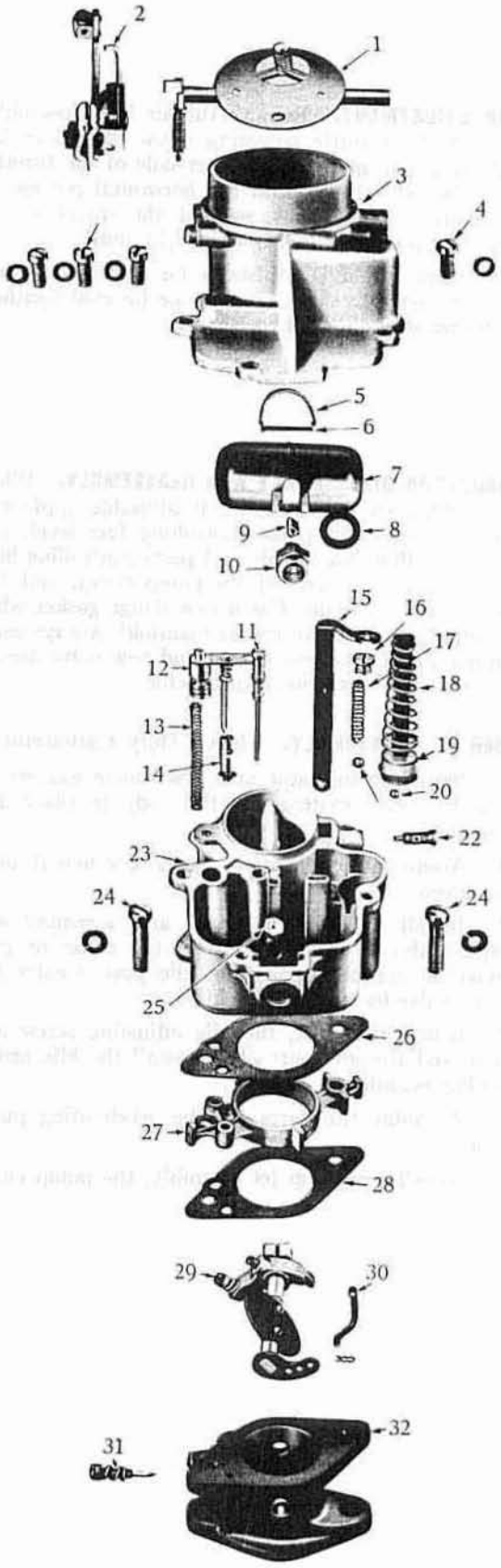
Heavy Duty Carburetor Parts

1. Choke tube bracket assembly.
2. Choke control lever, shaft and valve assembly.
3. Air horn assembly.
4. Air horn attaching screws.
5. Float lever pin retainer.
6. Float lever pin.
7. Float.
8. Float needle seat gasket.
9. Float needle.
10. Float needle seat.
11. Idle orifice tube and plug assembly.
12. Step-up piston, plate and rod assembly.
13. Step-up piston spring.
14. Step-up jet and gasket assembly.
15. Pump connector link.
16. Pump check plug.
17. Pump check spring.
18. Pump spring.
19. Pump plunger and rod assembly.
20. Pump cylinder ball.
21. Pump check ball.
22. Pump jet assembly.
23. Carburetor main body.
24. Carburetor flange attaching screw.
25. Main metering jet and gasket assembly.
26. Flange gasket.
27. Insulator.
28. Flange gasket.
29. Throttle shaft, arm, throttle lever, throttle shaft dog and throttle valve assembly.
30. Pump operating link.
31. Idle adjusting screw and spring.
32. Body flange, pump check plug and rivet plug assembly.



Heavy Duty carburetor parts.

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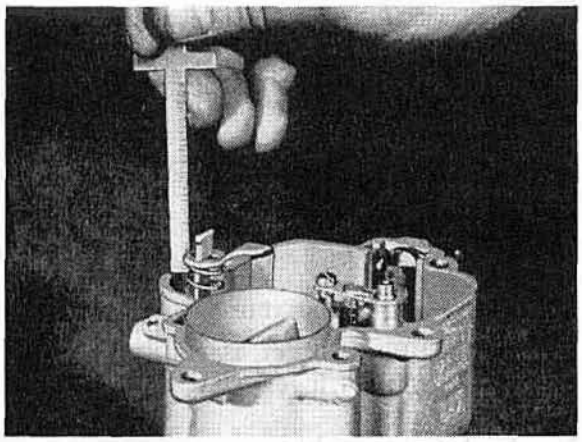

PUMP ADJUSTMENT. Remove the air horn assembly, back out the throttle adjusting screw and place the pump operating link in the center hole of the throttle shaft arm. To adjust, bend the horizontal portion of the pump connector link so that the travel of the pump plunger shaft is 25/64" (9,92 mm).

The pump stroke is adjustable for high or low temperatures. Set it to the longest stroke for cold weather, the shorter stroke for hot weather.

CARBURETOR DISASSEMBLY AND REASSEMBLY. When disassembling the carburetor, it is advisable to place in separate groups (1) parts controlling fuel level, (2) parts controlling idle circuit, (3) parts controlling high speed circuit, (4) parts of the pump circuit and (5) parts for choke circuit. Use a new flange gasket when installing the carburetor on the manifold. Always use a complete new gasket assortment and new valve assembly screws when servicing a carburetor.

ORDER OF REASSEMBLY. Heavy Duty Carburetor.

1. Place the insulator and new flange gaskets on the body flange casting, set the body in place and tighten the screws.

2. Assemble the idle circuit parts. Use new throttle valve screws.

3. Install the throttle shaft, arm assembly and throttle valve. The small "c" in the circle or part number should be toward the idle port. Center the throttle valve by tapping it lightly.

4. Install the rivet, the idle adjusting screw and spring, and the idle port plug. Install the idle orifice and plug assembly.

5. Assemble the parts for the accelerating pump circuit.

6. Install the pump jet assembly, the pump check needle and plug, and the ball and pump retainer ring in the pump cylinder.

7. Position the pump connector link. Use the inner hole for a short stroke and the outer hole for a long stroke.

8. Assemble the parts controlling the high speed circuit. Check the springs for damage.

9. Install the main metering jet, the step-up jet and gasket assemblies.

10. Install the step-up piston, gasket, spring and the step-up piston plate and rod assembly.

11. Assemble the parts controlling the fuel level. Check the float for dents or wear on the lip. Check the float pin for wear. If the needle shows a groove on the seating surface, replace both the needle and seat.

12. Install the needle seat and gasket assembly, needle, float pin, float and lever assembly and the retainer. Set the float level to specifications by bending the lip, not the float.

13. Install the air horn casting.

14. Assemble the parts for the choke circuit.

15. Install the choke control lever and shaft assembly (check for loose lever). Install the choke valve assembly (use new screws).

16. Install the choke tube bracket assembly, spring, choke connector rod and throttle shaft dog and the throttle lever assembly.

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GASOLINE DIAGNOSIS

EXCESSIVE GASOLINE CONSUMPTION.

DESCRIPTION

Before any corrective measures are undertaken, a test run should be made at a car speed of approximately 30 M. P. H. using a test tank or an accredited mileage tester. An accurate record of the mileage obtained should be kept. The test should be made in conventional gear on a level road at constant speed, both directions of the road. If the gasoline economy obtained is low, the following causes should be checked and a second test run made over the same course under similar conditions. It is often advisable to invite the owner to accompany the service men on a test run to insure that the owner is familiar with the actual economy obtained during the test. At this time the service man can explain that the type of operation has a material effect upon gasoline economy.

CAUSES

1. Caused by type of operation:
   - A. Sustained high speed.
   - B. Long periods of idle operation.
   - C. Abnormally fast engine idle speed (throttle not closed).
   - D. Numerous starts and stops in congested traffic.
   - E. Car operated on short trips only.
   - F. Failure to use engine warming devices such as, engine cooling system thermostat, radiator covers, etc., in cold weather.
2. Caused by units other than the carburetor:
   - A. Faulty ignition due to:
     1. Incorrect timing (especially late ignition).
     2. Improperly spaced distributor points.
     3. Weak ignition condenser.
     4. Weak ignition coil.
     5. Cracked or chafed wiring insulation.
     6. Defective or incorrectly spaced spark plugs.
   - B. Restricted or partially clogged carburetor air cleaner.
   - C. Restricted or partially clogged carburetor muffler.
   - D. Abnormal rolling resistance due to:
     1. Dragging brakes.
     2. Tight wheel bearings.
     3. Excessive front wheel toe-in or toe-out.
     4. Excessive friction in power transmitting units.
     5. Under inflated tires.
   - E. Fuel pump diaphragm leakage.
   - F. Excessive fuel pump pressure.
   - G. Poor engine compression.
   - H. Partially clogged or restricted exhaust pipe, muffler or tail pipe.
   - I. Pre-ignition.
   - J. Engine or transmission clutch slippage.
3. Condition caused by improper carburetor adjustment:
   - A. Float level too high.
   - B. Float leaking and partially filled with fuel.
   - C. Float needle valve leaking.
   - D. Improper adjustment of accelerating pump.
   - E. Improper adjustment of metering rod. (Carter carburetor.)
   - F. Internal leakage in carburetor due to:
     1. Improperly seating accelerating pump valve.
     2. Fractured passages.
   - G. Use of improper size metering rod. (Carter carburetor.)
   - H. Loose plugs or damaged gasket at base of main discharge jet nozzles.
   - I. Carburetor throttle stop screw set too fast.
   - J. External carburetor leaks.
4. Leaks occurring in the gasoline tank or lines.

MANIFOLD LEAKS — INTAKE AND EXHAUST.

CAUSES

1. Loose manifold connections or leaks occurring in vacuum lines (intake manifold).
2. Loose manifold nuts.
3. Insufficient threads on manifold attaching studs permitting nuts to bottom.
4. Distortion or misalignment existing at gasket surfaces on:
   - A. Intake manifold.
   - B. Exhaust manifold.
   - C. Carburetor attaching flange.
5. Damaged or improperly installed gaskets.
6. Improper registry between parts in manifold and cylinder block.
7. Restriction in exhaust pipe, muffler or tail pipe (excessive back pressure).

FUEL PUMP LEAKAGE AND INSUFFICIENT FUEL DELIVERY.

CAUSES

1. Restricted gasoline tank cap vent.
2. Restricted or partially clogged gasoline tank to fuel pump line.
3. Air leak occurring at connections or in gasoline tank to fuel pump lines.
4. Restricted or partially clogged gasoline tank outlet pipe assembly.
5. Air leak occurring above fuel level in gasoline tank outlet pipe assembly.
6. Restricted or partially clogged fuel pump screen.
7. Fuel pump filter bowl loose.
8. Damaged or improperly installed bowl gasket.
9. Punctured or worn out diaphragm.
10. Leak around diaphragm shaft or pull rod.
11. Loose valve seats in fuel pump.
12. Improperly seating fuel pump valves (replace).
13. Sticking fuel pump valves.
14. Rocker arm shaft (pin) out of position.
15. Broken rocker arm.
16. Vapor in line between tank and pump (vapor lock).

FUEL PUMP NOISE.

DESCRIPTION

Fuel pump noise very closely resembles a tappet noise, although at times the noise is somewhat lighter than a tappet noise. Like tappet noises, a fuel pump noise is encountered at camshaft speed.

TEST

Allow the engine to idle and check for noise with a sounding rod against the fuel pump body. In some instances fuel pump noise can be detected by tightly gripping the pump body with the hand and noting if a "bump" or vibration is felt.

CAUSES

1. Weak or broken rocker arm contact spring.
2. Worn rocker arm or rocker arm pin.
3. Fuel pump body loose on engine.
4. Scored operating lever or camshaft eccentric.
5. Interference of fuel pump lever with inner surface of crankcase.

THERMOSTATIC TYPE FUEL GAUGE DOES NOT OPERATE PROPERLY.

Connect a good spare tank unit to the gasoline gauge, being sure to run a ground wire from the tank unit to a good ground on the car frame. Allow approximately 1 minute to 1-1/2 minutes for the gauge to come to its true reading after turning the ignition switch on. Then, moving the tank unit float arm by hand, check the gauge action with the table.

	Gauge Reading	
Tank Condition	Black Wire Grounded	Black & Red Wire Grounded
Empty	Empty	1/2 Full
1/2 Full	1/4 Full	3/4 Full
Full	1/2 Full	Full

	Gauge Reading	
Tank Condition	Black Wire Open	Black & Red Wire Open
Empty	1/2 Full	Empty
1/2 Full	Full +	Empty
Full	Full +	Empty

If the gauge does not record correctly, the fault is in the dash unit, while if the gauge operates satisfactorily the trouble is either in the wiring or the tank unit. To check the wiring, insert a 6-volt test light with small bulb in series between the tank unit and the wiring to the dash gauge. With the ignition switch "On" the lamp should go on and off at regular intervals, indicating that the wire is satisfactory. If the lamp does not light, it indicates either a ground or open circuit in the wire. This test should be made on both connecting wires.

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ELECTRICAL SECTION

GENERAL

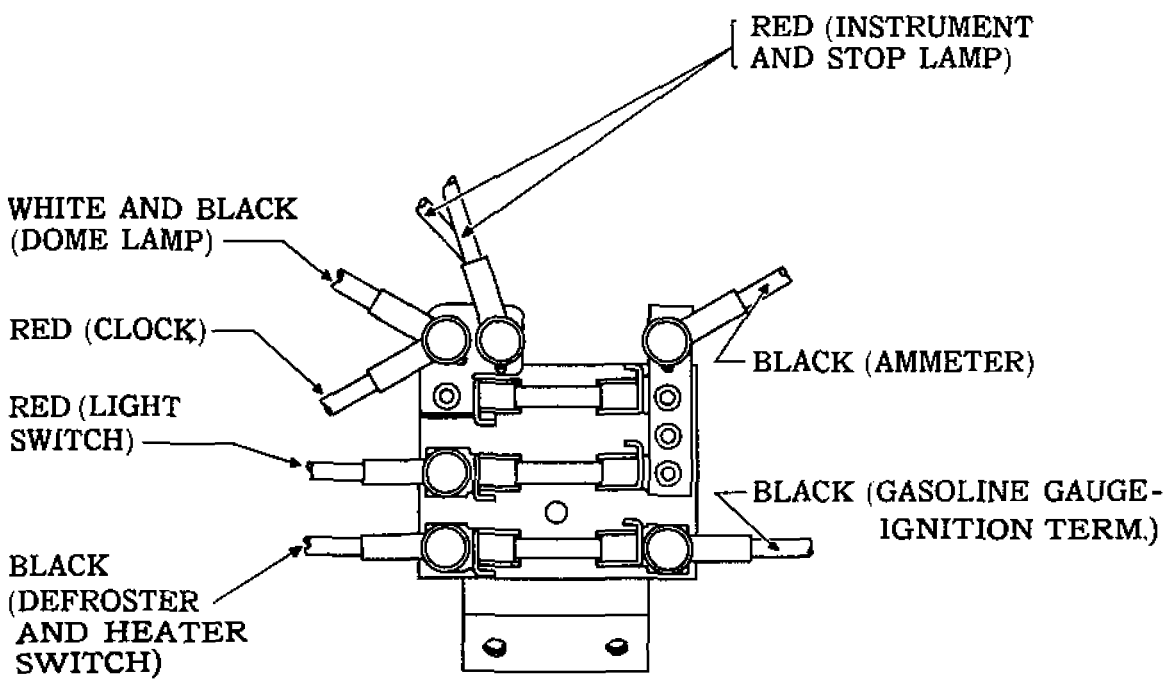
• Conventional single wire type electrical circuits (positive pole grounded to the frame) using a six to eight volt battery ignition, are used on all models. High output shunt-wound generators with fully automatic current and voltage control carry the maximum current loads. Non-spill batteries equipped with caps and vents prevent over-filling.

The starters are provided with Bendix drives. Ignition systems on all models are protected against weather and "shorting" by lacquered high tension cables. The distributor caps are thoroughly waterproofed and the coils are located in high, protected positions.

Six lobe cam distributors with single sets of breaker points are used on all models. Headlamps are the sealed beam type with the filament, reflector and lens contained in one sealed unit.

SERVICE TOOLS — ELECTRICAL SYSTEM

600 Armature Lathe	40 Battery Hydrometer	38 Distributor Point Aligning Tool
700 Undercutter	Y-83 Syncrograph Engine Analyzer	40 Distributor Point Gap Dial Indicator
E-192 Volt-Amp Tester	*J-544-S Spring Tension Scale*	*8003-A Head Lamp Aiming Screen*



ALL MODELS Three 20-ampere fuses are provided in the electrical circuits to protect against damage due to a ground or short circuit. An auxiliary fuse is provided in the accessory circuit to prevent blowing the main fuses under temporary overloads.

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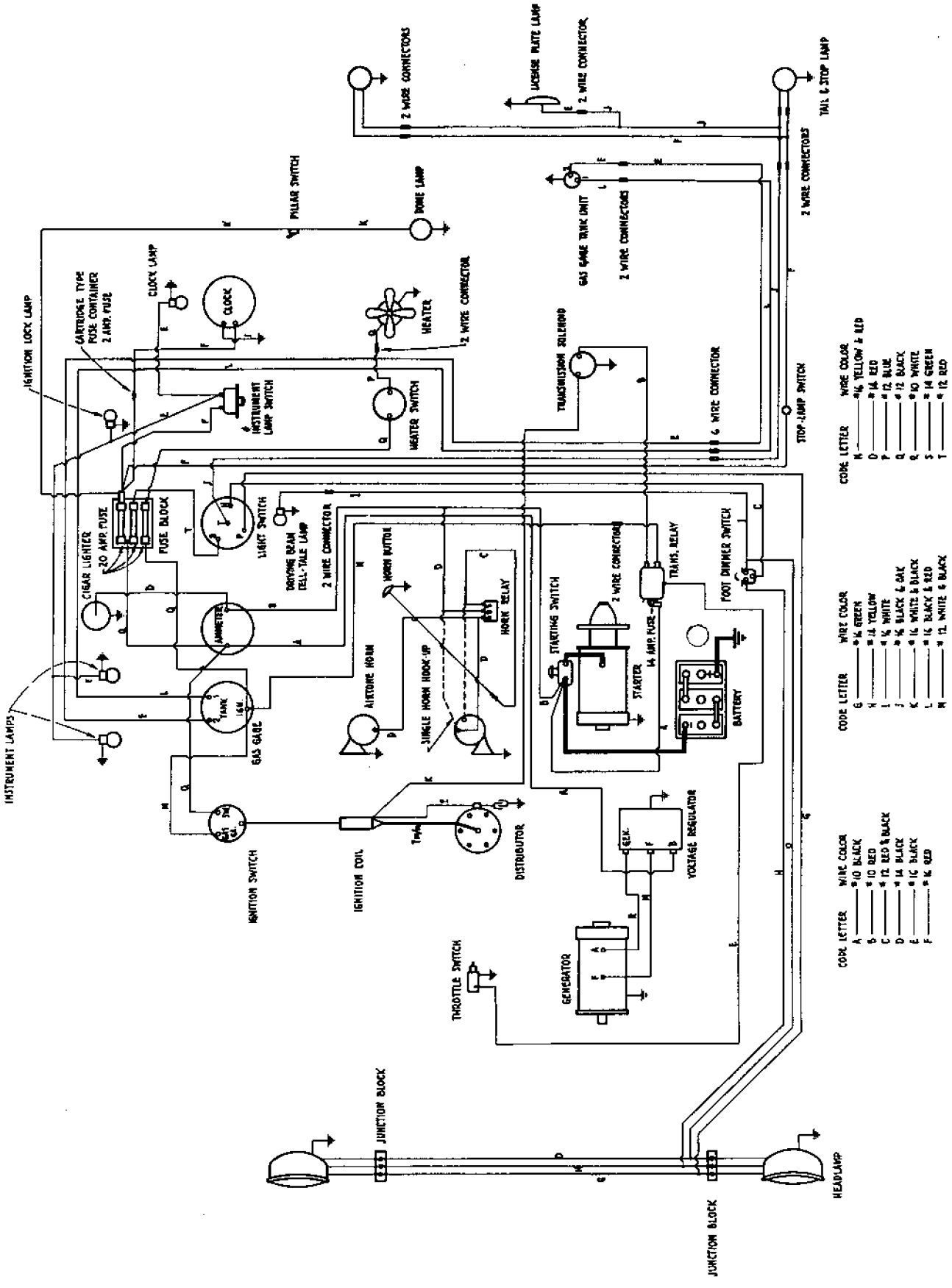

Wiring diagram of the electrical system used in all models.

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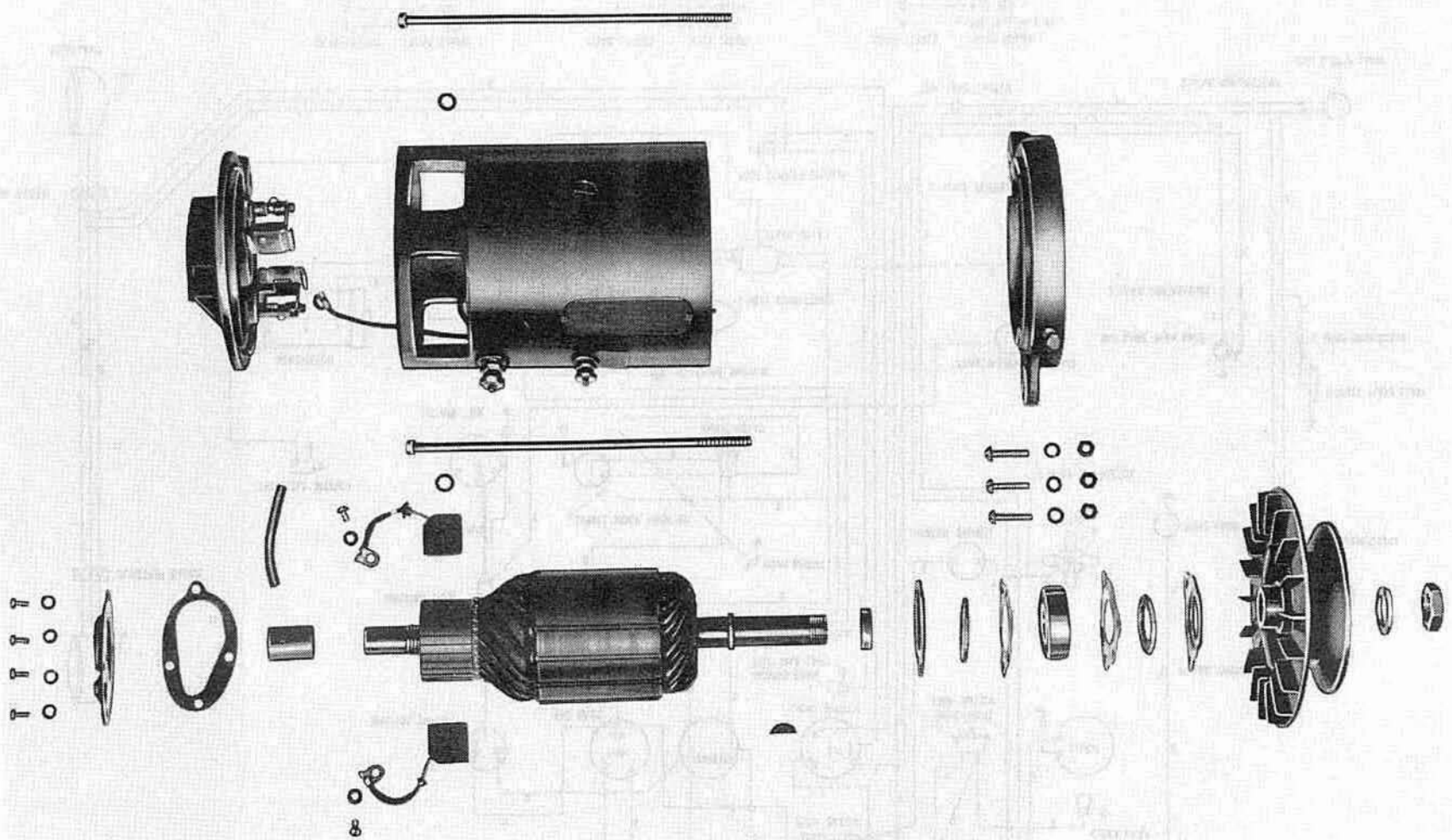
All Models — Parts of the generator in their order of assembly.



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GENERATOR

	Coupe Express	Standard	Heavy Duty
Make	Auto-Lite	Auto-Lite	Auto-Lite
Model	GDZ-4804-A	GDZ-4804-A	GDZ-4805-A
Capacity—Watts	280	280	280
Output Amps. —Cold	35	35	35
Output Amps. —Hot	35	35	35
Gen. to Engine Speed Ratio	1.75	1.75	1.74
How Regulated	Volt. Current Reg.	Volt. Current Reg.	Volt. Current Reg.

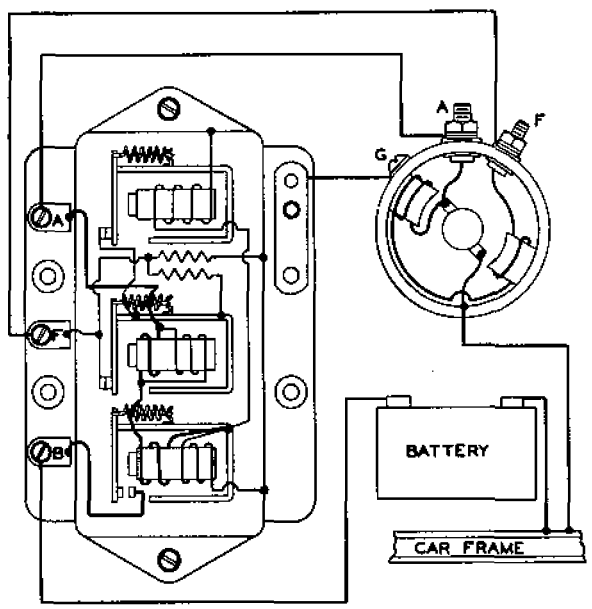
ALL MODELS

1. Lubricate every 5,000 miles (8.046 km) with S. A. E. No. 20 engine oil.
2. If the commutator becomes rough or worn so that the brush surface of the mica and copper segments are nearly even, the outside surface of the commutator should be turned true and the mica segments undercut.
3. Examine the generator brushes periodically — replace worn ones.

CURRENT AND VOLTAGE REGULATOR

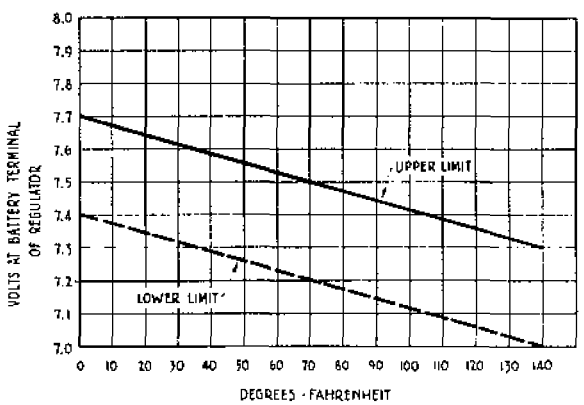
ALL MODELS To test the voltage regulator, connect an accurate ammeter, with heavy short leads, between the regulator "B" terminal and the lead removed from this terminal; at the same time connect an accurate voltmeter across the regulator "B" terminal and the ground. Check the battery to see that it is fully charged (specific gravity at least 1.250). If the battery is not fully charged, replace it temporarily with one that is.

Start the engine, set the speed at about 30 M.P.H. (48,3 km.) and run for several minutes, or until the voltage remains constant for accurate readings. The ammeter should read below 33 amperes and the voltage should read between 7.20 and 7.50 at 70° F. (21° C.). Readings in accordance with these figures indicate correct functioning.



ALL MODELS To test the current regulator, use a partially discharged battery and the same connections as given above. Add a current load in excess of 33 amperes (by turning on lights, radio, heater, etc., or inserting a suitable resistor) at a point between the car ammeter and the battery. Correct current regulator functioning will show a reading of 33 to 35 amperes. If a regulator does not test accurately, it should be referred to an official Auto-Lite Service Station. The regulator is sealed and the seal should not be broken.

The voltage output curve at the right shows the change in voltage with the corresponding change in temperature of the regulator.



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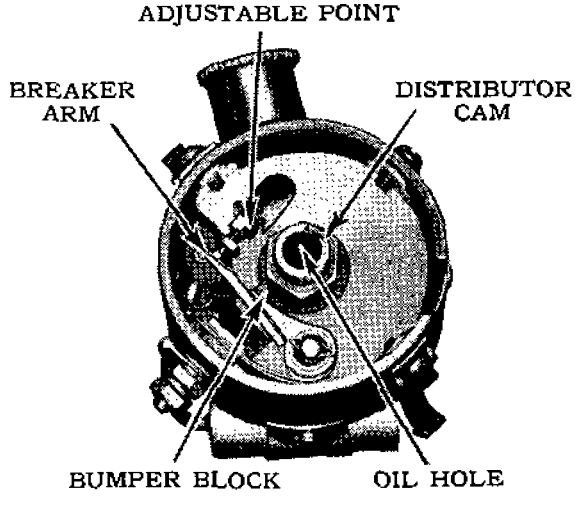
DISTRIBUTOR

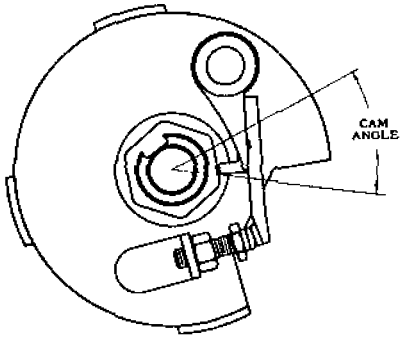
	Coupe Express	Standard	Heavy Duty
Distributor Make	Electric Auto-Lite	Electric Auto-Lite	Electric Auto-Lite
Model Number	1-GW-4154	1-GW-4154	1-GW-4101
Spark Control Type	Full Automatic	Full Automatic	Full Automatic
Auto. Adv. Degrees (Crankshaft)	14° 2° B.T.C.D.	14° 2° B.T.C.D.	22° 2° B.T.C.D.
Timing Distributor Breaker Gap	.020" (0,508 mm)	.020" (0,508 mm)	.020" (0,508 mm)
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Ign. Coil Make	Electric Auto-Lite	Electric Auto-Lite	Electric Auto-Lite
Ign. Coil Model	CE-3224-W	CE-3224-W	CE-3224-VS
Spark Modifier	Yes	Yes	Yes
Spark Modifier Make	Auto-Lite	Auto-Lite	Auto-Lite
Vac. Adv. Degrees (Crankshaft)	18°	18°	12°



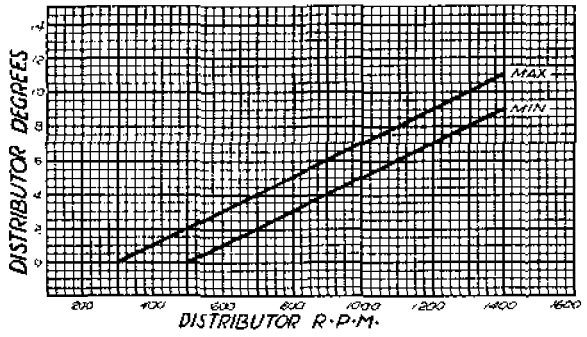
ALL MODELS The distributor used on Coupe Express and Standard models has 7° automatic advance (14° on engine flywheel). On the Heavy Duty models, the advance is 11° (22° on vibration damper flywheel).

ALL MODELS Whenever service work is performed on the distributor, check the breaker arm tension. A pull of from 17 to 20 ounces should be required to break the points. The tension can be adjusted by shifting the breaker point arm spring at its point of attachment to the distributor. Tool No. 36 is recommended for the operation. Also examine the breaker point contacts. Use Tool No. 38 to align the points.

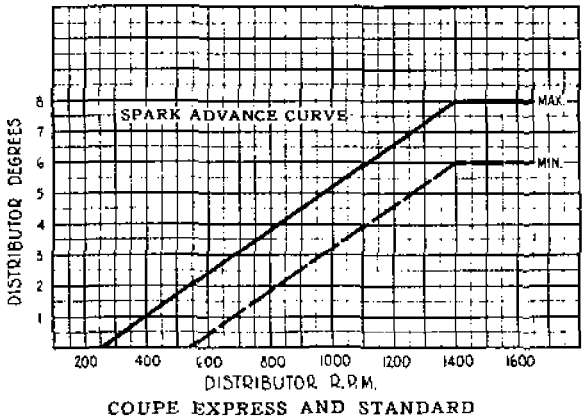
ALL MODELS Space the breaker point gaps at .020" (0,508 mm). To change the gap, loosen the lock nut on the adjustable point to permit moving it. Have the bumper block on the breaker arm on a high point of the cam while checking the point gap. When the correct spacing is obtained, tighten the lock nut and check the spacing again to make sure it has not been changed by tightening the lock nut. Use the point spacing indicator No. 40.



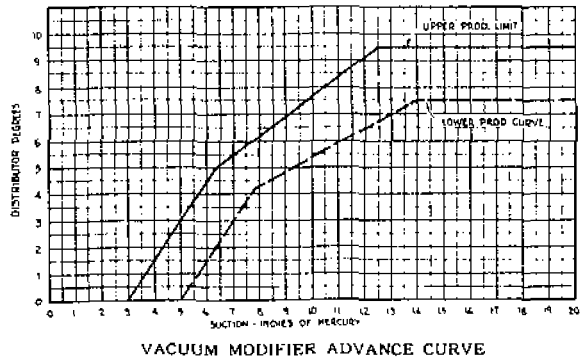
ALL MODELS The cam angle is the amount of rotation of the distributor cam in degrees that occurs while distributor points are closed. The cam angle on all models is 35°.



SPARK ADVANCE CURVE — HEAVY DUTY



COUPE EXPRESS AND STANDARD



VACUUM MODIFIER ADVANCE CURVE
COUPE EXPRESS AND STANDARD

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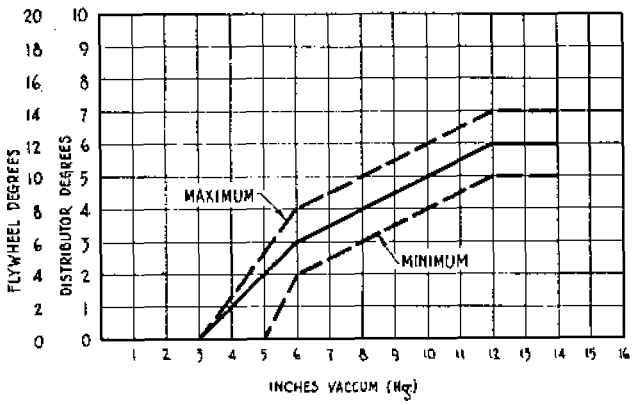
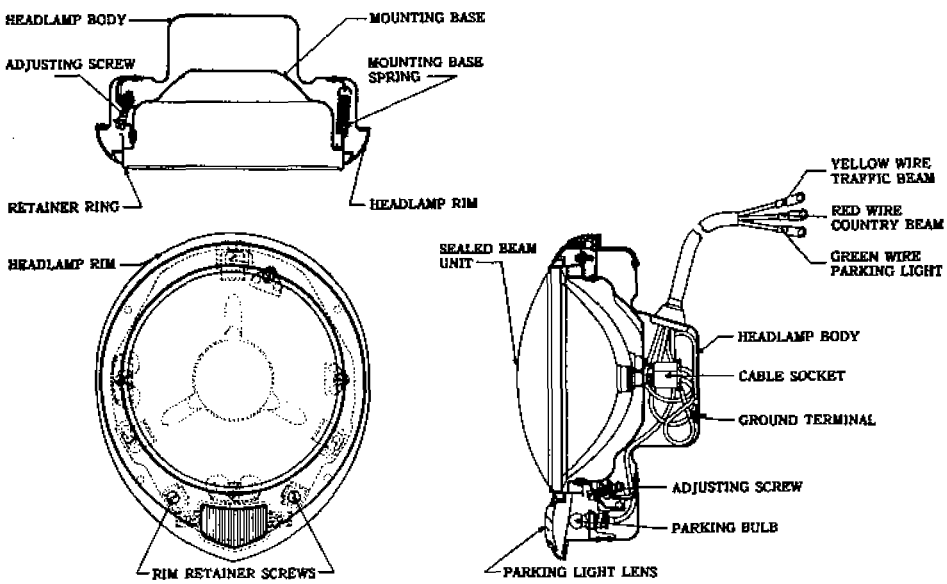


HEAVY DUTY Vacuum advance curve.

HEADLAMPS



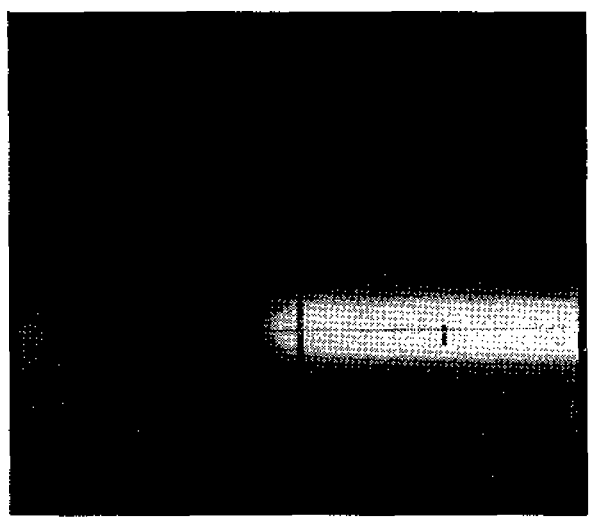
Construction of the headlamp.

LAMP BULB SPECIFICATIONS — GENERAL ELECTRIC MAZDA

	Head	Parking	Rear	Stop	Inst.
Coupe Express	4030	55	1158	1158	55
Standard	4030	55	1158	1158	55
Heavy Duty	4030	55	1158	1158	55

NOTE: Export Headlamp Bulb No. 2520.

ALL MODELS When aiming the head lamps, the car should not be loaded. Line up the center of the car with the center of the screen. Set the height of the horizontal line on the screen 3″ (76,2 mm) below the height of the center of the head lamps. Measure the distance from the center of the front grille to the center of the head lamp. Then set the vertical beam mark the same distance from the center line of the screen. Aim the light beam so that the zone of high intensity is intersected by the horizontal line 3″ (76,2 mm) below the head lamp center, and the vertical line directly ahead of the head lamp. Perform the adjustment for each lamp separately. No further adjustment necessary for the traffic beam.



Beam position on chart.

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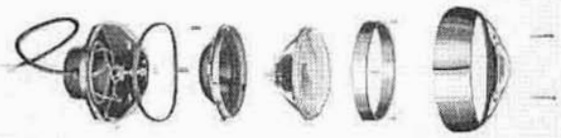
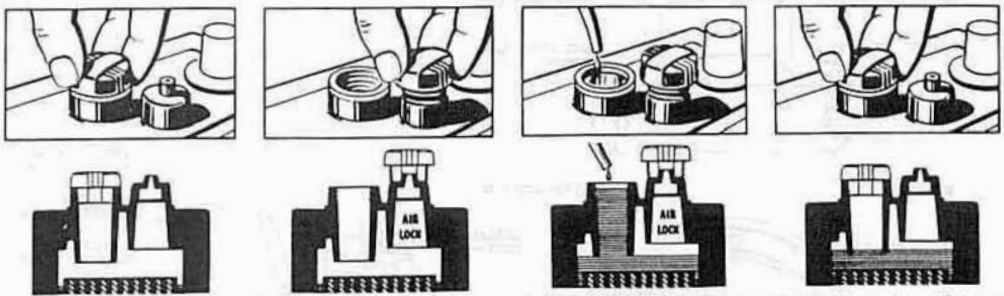


ALL MODELS Parts of head lamp in the order of their assembly.

ALL MODELS To remove the head lamp rim, take out the two holding screws, and lift the rim outward and upward. Then loosen the three retaining rim screws. When removing the retaining rim, hold the head lamp unit to prevent its falling. Pull the unit carefully outward and disconnect it by pulling it off the socket.

BATTERY

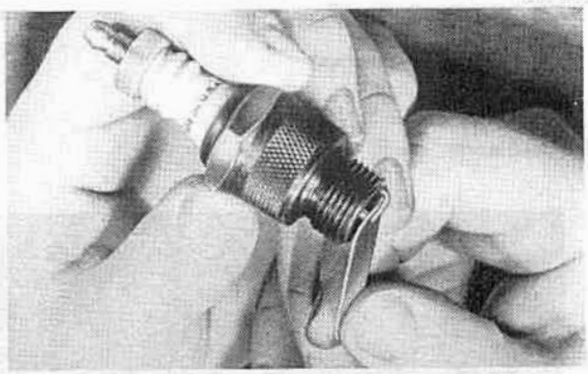
	Coupe Express	Standard Model	Heavy Duty Model
No. of Plates	13	13	13
Capacity—Amp. Hrs.	90	90	90
Terminal Grounded	Positive	Positive	Positive



1. Remove filler-cap.
2. Place cap on safety-vent forming air lock in breather-chamber.
3. Fill well with distilled water. Air lock prevents solution rising above bottom of well.
4. Remove cap from safety-vent and solution drops to correct level. Replace cap in filler hole.

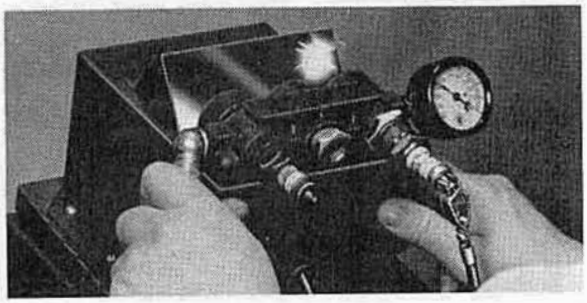
Battery filling instructions.

SPARK PLUGS



Spacing electrode gaps.

	Coupe Express	Standard	Heavy Duty
Spark Plug Make	Champ. J-9	Champ. J-9	No. 6 Com.-62
Spark Plug Size	14 mm	14 mm	18 mm
Spark Plug Gap	.022" (0,56 mm) / .027" (0,686 mm)	.022" (0,56 mm) / .027" (0,686 mm)	.022" (0,56 mm) / .027" (0,686 mm)



ALL MODELS Maximum engine efficiency requires spark plugs in the best of condition. Spark plugs should be cleaned and respaced at 5,000 mile (8.048 Km.) intervals. After cleaning and respacing, spark plugs should be tested under pressure as shown at the left.

For peak engine efficiency, spark plugs should be respaced every 10,000 miles (16.096 Km.).

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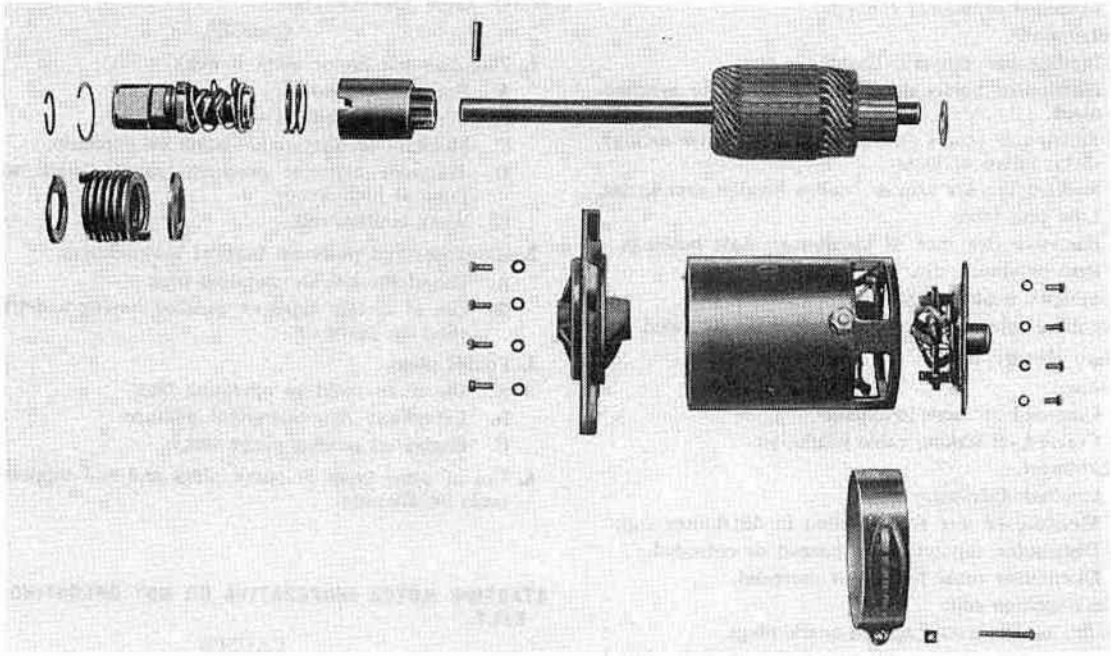
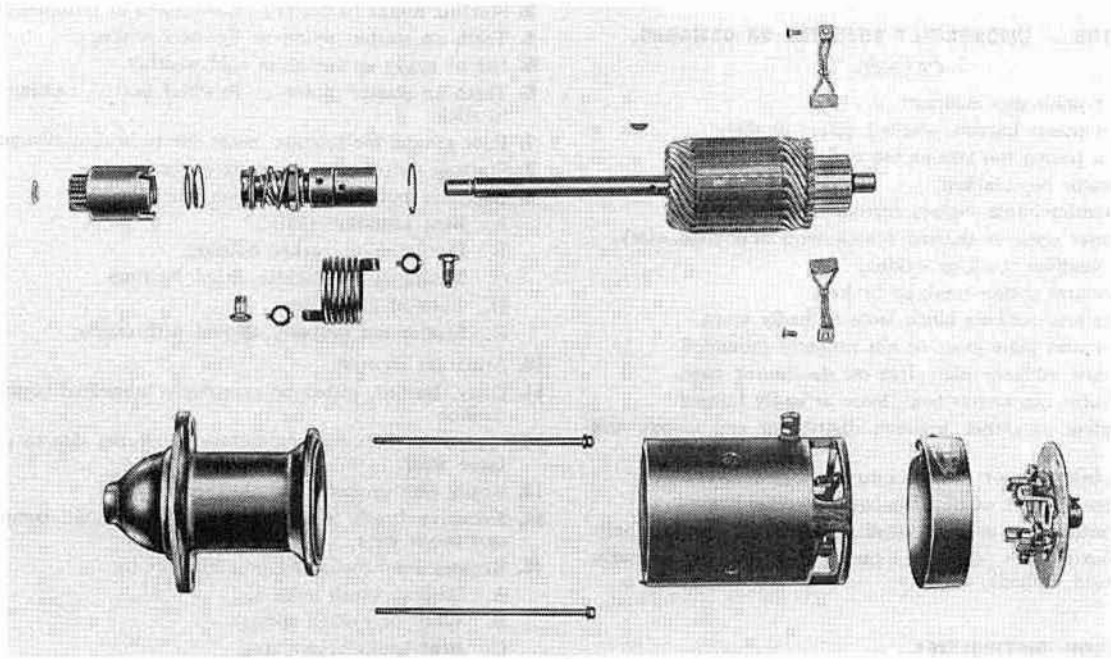
STARTER MOTOR

	Coupe Express	Standard	Heavy Duty
Model	MZ-4090	MZ-4090	MAW-4020
Normal Engine Cranking Speed — R.P.M.	130	130	130
Normal Torque—Ft. Lbs.	4.3	4.3	4.75
Lock Amperes	560	560	670
Lock Voltage	4	4	4

	Coupe Express	Standard	Heavy Duty
No. of Teeth in Flywheel	124	124	133
No. of Teeth on Pinion	9	9	9
No. Load — Bench Test — R.P.M.	4300	4300	4900
Voltage	5-1/2	5-1/2	5-1/2
Amperes	70	70	65



Coupe Express and Standard.



Heavy Duty.

ALL MODELS Parts of the starting motor in the order of their assembly. Note that on the Coupe Express and Standard motor a left-hand spring is used, while a right-hand spring is used on the Heavy Duty motor.

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ELECTRICAL DIAGNOSIS

FAULTY IGNITION.

CAUSES

1. Primary circuit.
   - A. Wiring.
     1. Loose or corroded terminals.
     2. Insulation cracked or worn through.
     3. *Faulty ground connection.*
   - B. Ignition switch.
     1. Loose contacts.
     2. Corroded or burned contacts.
   - C. Distributor.
     1. Ignition not properly timed.
     2. *Distributor points not properly spaced or synchronized.*
     3. Distributor points coated, (due to excessive arcing), dirty, pitted or loose.
     4. Sticking breaker arm or broken breaker arm spring.
     5. Low cam lobe.
     6. Excessive clearance of distributor shaft bushings.
     7. Bent or sprung distributor shaft.
   - D. Condenser weak or grounded.
   - E. Overdrive solenoid improperly wired or grounded.
2. Secondary circuit.
   - A. Wiring.
     1. *Corroded or loose terminals.*
     2. Cracked or leaking cable insulation.
   - B. Distributor.
     1. Cracked distributor cap.
     2. Moisture or dirt accumulation in distributor cap.
     3. Distributor cap terminals burned or corroded.
     4. *Distributor rotor burned or corroded.*
   - C. Weak ignition coil.
   - D. Faulty or incorrectly spaced spark plugs.
   - E. Use of spark plug to coil suppressor on radio installations.

DISTRIBUTOR — INCORRECTLY ADJUSTED OR DAMAGED.

CAUSES

1. Breaker point gap incorrect.
2. Breaker points burned, cracked, pitted or dirty.
3. Ignition timing too late or too early.
4. Distributor cap cracked.
5. High tension cable sockets corroded.
6. Condenser open or shorted (check with new condenser).
7. Spark modifier stuck or leaking.
8. Breaker arm spring weak or broken.
9. Breaker arm rubbing block loose or badly worn.
10. Breaker arm plate loose or *not properly grounded.*
11. Automatic advance plate free on distributor base.
12. Distributor cap inserts bent, loose or badly burned.
13. Insufficient clearance between distributor cap inserts and rotor.
14. Grounded rotor or broken rotor spring.
15. *Distributor shaft or bushings worn.*
16. Distributor drive gear or coupling sheared or loose on shaft.
17. Distributor drive gear or oil pump drive gear not properly assembled (timed).

IGNITION COIL DIFFICULTIES.

CAUSES

1. Primary winding.
   - A. Shorted (ignition current draw abnormally large — weak spark).
   - B. Grounded (ignition current does not drop to zero when contacts separate).
2. Secondary winding shorted or grounded (weak spark).
3. Improper ground between *coil and attachment.*
4. Loose or faulty ignition switch contacts.
5. Loose contact of distributor to coil secondary cable in coil tower.
6. Use of a coil other than standard equipment.
7. Faulty ammeter.

SPARK PLUG DIFFICULTIES.

CAUSES

1. Plug does not fire or spark is weak.
   - A. *Porcelain cracked.*
   - B. Porcelain carbonized or burned.
   - C. Moisture or dirt accumulation on porcelain.
   - D. Electrode gap not properly spaced (spark will not jump at high speed).
   - E. Weak ignition coil.
2. *Electrodes and porcelain* burn at low mileages.
   - A. Use of too hot an operating plug.
   - B. Use of certain types of gasoline having a detrimental effect on porcelain.
3. Fouled plugs.
   - A. Use of too cold an operating plug.
   - B. *Excessively rich carburetor mixture.*
   - C. Engine oil passing piston rings.
4. Use of some types of spark plugs and coil suppressors in radio installations.

STARTING MOTOR INOPERATIVE OR NOT OPERATING PROPERLY.

CAUSES

1. Dead or undercharged battery.
2. Poor battery ground or corroded battery terminals.
3. Starting motor to battery cable broken or terminal cracked.
4. Teeth on starter pinion or flywheel broken.
5. Use of heavy engine oil in cold weather.
6. Teeth on starter pinion or flywheel burred, causing starter to stick.
7. Poor ground for starting motor due to broken ground cable.
8. Starting switch not operating properly.
9. Excessive resistance to rotation due to:
   - A. Bent armature shaft.
   - B. Distorted or cracked housing.
   - C. Misaligned or tightly fitted bearings.
   - D. Lack of lubrication.
   - E. Starter not properly aligned with engine.
10. Armature shorted.
11. Dirty, burned, pitted or excessively lubricated commutator surface.
12. High mica between commutator segments due to commutator wear.
13. Brush ring grounded or set incorrectly.
14. Excessive brush spring tension causing rapid commutator and brush wear.
15. Brushes not functioning properly due to:
   - A. Sticking brush holders.
   - B. Weak or broken springs.
   - C. Bent brush holder arms.
   - D. *Brushes worn too short.*
   - E. Brushes sticking in guides.
   - F. Incorrect type of brushes.
   - G. Brush connections or pig tails loose.

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STARTER DRIVE NOISES.

DESCRIPTION

The most common starter drive noise due to causes Nos. 1, 2 and 5 is a pronounced grind when the starter motor is operating. This grind is similar to, but louder than, the normal starter noise when the engine is being cranked and should not be confused. A hissing noise will indicate cause No. 3 while cause No. 4 will be indicated by an intermittent rubbing noise. If the starting motor is not rigidly attached, a knock or "bump" will be heard when the starter pinion engages.

CAUSES

1. Starter pinion teeth chipped or damaged.
2. Flywheel gear teeth chipped or damaged.
3. Sprung or distorted drive shaft.
4. Starter motor not properly mounted (misaligned).
5. Starter motor loose on engine.
6. Starter motor armature shaft bearing worn, broken or dirty.

GENERATOR INOPERATIVE OR NOT CHARGING PROPERLY.

CAUSES

1. Slipping fan belt.
2. Ammeter indicates incorrect or no charging rate (check with master ammeter).
3. Generater pulley loose on shaft.
4. Relay points remaining open.
5. Incorrect size generator drive pulley.
6. Too low an engine idle speed — free wheeling cars.
7. Improper regulator operation.
8. Open armature (low or zero charging rate).
9. Grounded armature.
10. Loose pole (armature cannot be rotated easily).
11. Short between commutator bars.
12. Worn armature or bent shaft (generator noisy).
13. Improperly seated or worn brushes.
14. Incorrect type of brushes.
15. Commutator out of round.
16. High mica between commutator bars.
17. Weak or broken brush springs.
18. Greasy, charred or glazed commutator.
19. Sticking brush holder arms—brushes worn too short.
20. Brushes soft or oily (excessive lubrication).
21. Shorted, open or burned out field coils.

GENERATOR AND GENERATOR DRIVE NOISES.

DESCRIPTION

The most common of generator noises is a squeak resulting from causes Nos. 1 and 2. Causes Nos. 3 and 7 usually indicated by a knock at low speed although cause No. 3 may sometimes also cause a squeak. An intermittent knock increasing in frequency as the speed is increased, will indicate cause No. 4. A whine usually indicates causes No. 6 and 8.

CAUSES

1. Worn, damaged or defective generator bearings.
2. Insufficient bearing lubrication.
3. Pulley loose on shaft.
4. Cracked pulley.
5. Excessive end play of generator shaft.
6. Misalignment of generator belt.
7. Generator loose on engine.
8. Generator brush noises resulting from:
   - A. High mica insulators between commutator bars.
   - B. High commutator bars.
   - C. Rough commutator.
   - D. Dirty commutator.
   - E. Improperly seated brushes.
   - F. Hard spots in generator brushes.
   - G. Insufficient or excessive brush spring tension.
   - H. Generator brushes loose in holder.
   - I. Loose field magnets striking armature.

FREQUENT RECHARGING OF BATTERY NECESSARY.

CAUSES

1. Insufficient current flow to battery.
   - A. Inoperative generator.
   - B. Too low an engine idle speed—especially on free wheeling cars.
   - C. Loose connections in external circuit.
   - D. Corroded connections in external circuit (especially at battery terminals and frame ground strap).
   - E. Slipping fan belt.
   - F. Incorrect size generator drive pulley.
   - G. Regulator out of adjustment.
   - H. Ammeter registering higher charging rate than actual (check with master ammeter).
2. Excessive starting load causing abnormal current flow from battery.
   - A. Frequent use of starter motor.
   - B. Excessive use of the starter motor due to difficulty in starting.
   - C. High mica between commutator bars or badly worn or burned commutator.
3. Excessive lighting load due to:
   - A. Car operation confined largely to night driving.
   - B. Tail and stop light wires reversed.
   - C. Stop light switch inoperative (closed at all times).
   - D. Use of spot lights.
   - E. Unnecessary use of headlights while parking.
   - F. Ground or short in the lighting circuit.
4. Abnormal accessory load due to use of:
   - A. Car radio.
   - B. Car heater (electrically operated).
   - C. Windshield defroster.
   - D. Cigar lighter.
5. Internal discharge of battery.
   - A. Plates badly sulphated.
   - B. Cell leak due to cracked jar or sealing compound.
   - C. Water level not at proper height.
   - D. Plate separators ineffective.

ERRATIC HEAD LIGHTS.

CAUSES

1. Sealed Beam Units loose in sockets.
2. Loose or dirty connections between Sealed Beam Units and cable terminals.
3. Poor contacts in light switch.
4. Low or discharged battery.
5. Battery plates badly sulphated.
6. Improperly grounded headlamp bodies.
7. Faulty frame to battery ground (Sealed Beam Units burn out quickly).
8. Faulty generator action.
9. Faulty regulator operation.
10. Intermittent short circuit or ground in wiring assembly.
11. Loose connections at ammeter.

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COOLING SYSTEM

GENERAL

● Water temperature in the cooling system in all models is controlled by a thermostat, which regulates the opening and closing of the water system. While the engine is warming up the thermostat is closed, causing the water to recirculate through the engine block. As the engine reaches normal operating temperature the thermostat opens gradually.

The water pumps on all models are similar in design, having pre-lubricated shaft ball bearings and non-adjustable pump packing.

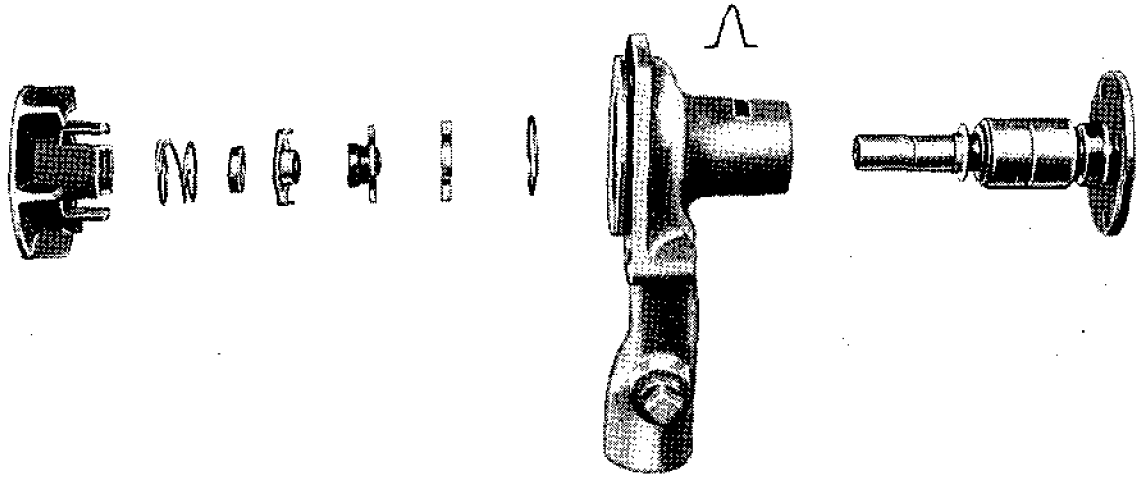
SPECIFICATIONS

	Coupe Express	Standard	Heavy Duty
By-Pass for Recirculation	No	No	Yes
Capacity — U. S. Quarts	10-1/2	10-1/2	13
Capacity — Imp. Quarts	8.75	8.35	10.8
Capacity — Liters	9,93	9,5	12,3
Lower Radiator Hose Inside Diameter	1-1/4" (31,75 mm)	1-1/4" (31,75 mm)	1-3/4" (44,45 mm)
Lower Radiator Hose Length	8-11/16" (220,6 mm)	8-11/16" (220,6 mm)	9-13/16" (249,2 mm)
Upper Radiator Hose Inside Diameter	1-1/4" (31,75 mm)	1-1/4" (31,75 mm)	1-1/4" (31,75 mm)
Upper Radiator Hose Length	8-1/4" (209,5 mm)	8-1/4" (209,5 mm)	9-21/32" (245,2 mm)
Fan Bearing Type	Pre-Packed; Ball	Pre-Packed; Ball	Pre-Packed; Ball
Fan to Engine Ratio	.972	.972	1.15

SERVICE TOOLS — COOLING SYSTEM

J-1501	*Water Pump Facing Tool*
J-708	Radiator Flusher

WATER PUMP AND FAN ASSEMBLY



Parts of the Coupe Express and Standard water pump.

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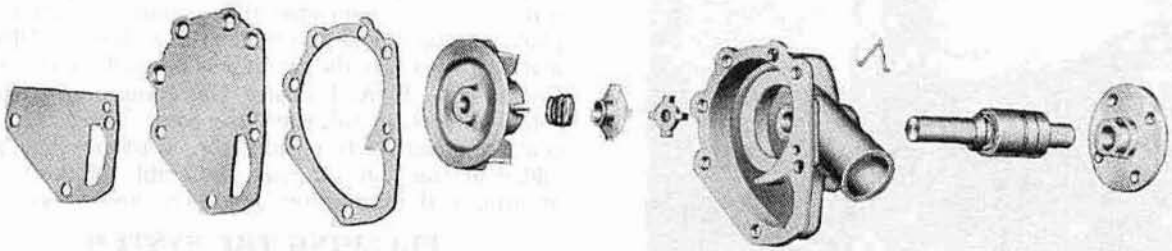
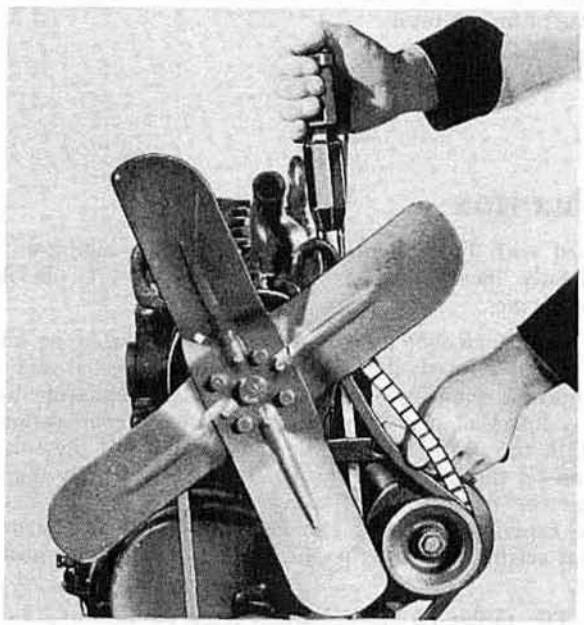


Parts of the Heavy Duty water pump.

ALL MODELS The water pumps on all models have pre-lubricated shaft ball bearings and non-adjustable pump packings. Under ordinary driving conditions further lubrication is not required for the life of the pump.

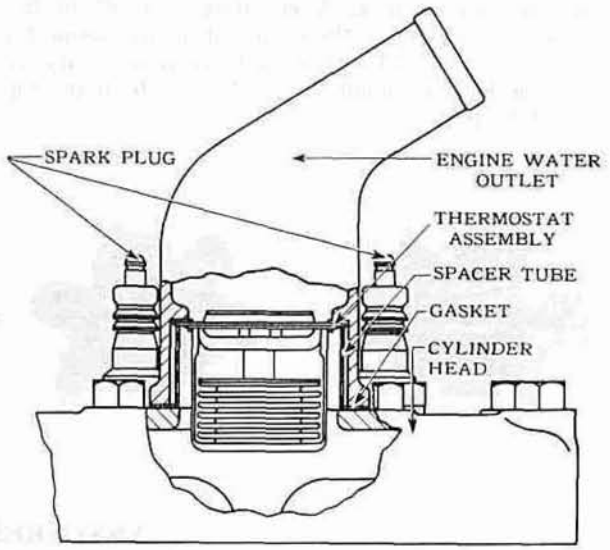
If the thrust seal surface becomes rough after long usage, it should be refaced with Water Pump Facing Tool No. J-1501. Where any part of the impeller assembly needs to be replaced, the entire assembly must be replaced. If the fan hub is removed, it should be replaced with a new one to insure a tight fit on the shaft. Press on the fan hub until it is flush with the end of the shaft. In pressing the impeller onto the shaft, allow 1/32" (0,793 mm) clearance between the impeller and the housing.

FAN BELT ADJUSTMENT



ALL MODELS The fan belt should be adjusted to provide from 3/8" to 1/2" (9,52 to 12,7 mm) slack movement in the belt. Adjustment is made by loosening the lock nut and the generator bracket screws. The correct adjusting tension is important to avoid undue strain on fan and generator bearings.

THERMOSTAT



ALL MODELS The rate of water flow is controlled by an automatic acting thermostat. The thermostat is so designed that when the valve is fully open, there is no restriction to water flow. When it is not functioning properly, replace the thermostat assembly. The thermostat valve is set to start opening at 151° F. to 155° F. (66° to 69° C.). This can be checked with an accurate thermometer and a pan of water warmed to a corresponding temperature. If its starts to open at a temperature of more than 2° above or below the established setting, the thermostat should be replaced. Never attempt to change the valve setting. Checking the temperature at the fully open point is not necessary.

IMPORTANT The thermostat must be installed with the thermostatic coil in the cylinder head opening. The end carrying the thermostat coil must be placed downward.

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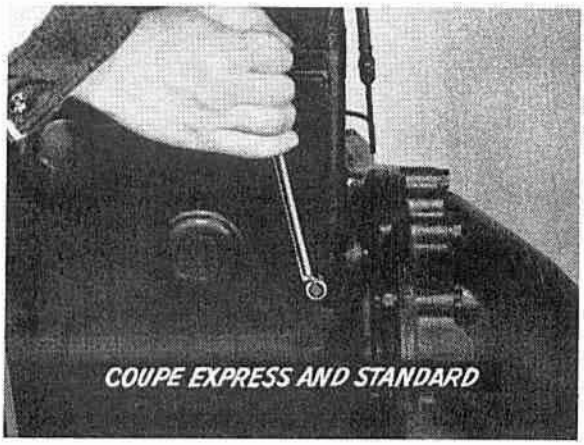
DRAINING THE SYSTEM



ALL MODELS Drain the radiator through the drain cock in the lower tank. To drain the system completely, remove the cylinder block plug located on the left side of the cylinder block toward the rear.

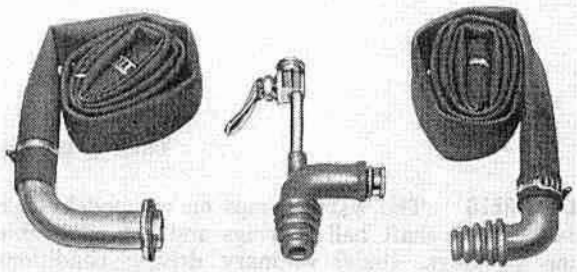
FILLING THE SYSTEM

• Because the thermostat valve is provided with a small hole which acts as a vent, the cooling system should not be refilled too rapidly. Too rapid filling will cause an air lock. After filling until all air has escaped, start and run the engine until the thermostat opens, and then add additional fluid, if necessary, to bring the level to about 2″ (50,8 mm) from the top of the filler pipe.

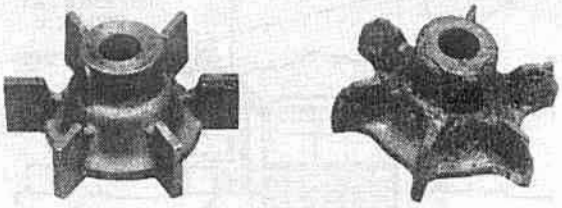
COOLING SYSTEM CORROSION

ALL MODELS To protect the radiator, cylinder block, cylinder head, thermostat and water pump from action of lime and other minerals usually present in water, it is recommended that a pint of Rustone be placed in the cooling system at the time of delivery and also whenever the radiator is drained, except when Prestone, G. P. A. Radiator Glycerine, or treated alcohol anti-freeze solutions are used. These solutions contain a satisfactory inhibitor. Rustone should be added at least once a year, preferably in the spring, or oftener if local water conditions are severe.

FLUSHING THE SYSTEM



If a cooling system inhibitor is not used, the system should be drained and flushed periodically, the frequency depending on local water conditions. The flusher illustrated is available through the Tool and Equipment Division under Tool No. J-708. Avoid the use of radiator cleaners containing strong caustic solutions.



The impeller on the right is badly corroded, while the impeller on the left was protected against rust through the use of an inhibitor.

ANTI-FREEZE SOLUTION

ALL MODELS The purpose of an anti-freeze solution is to lower the freezing point of the water in the radiator so that it will not freeze under cold weather operation. It must also permit the engine to operate at a temperature approximating that for which it was designed. The solution must not contain corrosive chemicals which will have a detrimental effect upon the metals of the cooling system.

If Prestone or G. P. A. Glycerine is used, it is important that all hose connections and cooling system gaskets be kept tight to avoid loss of these more expensive solutions through leakage.

If plain, untreated alcohol is used, it is advisable to use an inhibitor or rust preventive, such as Rustone. The principal brands of treated alcohol contain an anti-rust ingredient and Rustone SHOULD NOT be used with these solutions. A satisfactory inhibitor is already incorporated in the Prestone and G. P. A. Glycerine.

If any alcohol anti-freeze solution (treated or untreated) is used, it must be periodically tested and a sufficient quantity of alcohol added to compensate for any loss that may have occurred through evaporation. With the use of alcohol, do not spill any of the solution on the painted surfaces, as the alcohol may damage the finish. Excessive evaporation of alcohol may be experienced if any change is made in the thermostat setting to favor the operation of a hot water heater.

The tables on the following page indicate the correct quantity of the various anti-freeze solutions required for protection at the temperatures indicated.

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ANTI-FREEZE CAPACITY CHART

Coupe Express and Standard

Cooling System Capacity 10.5 U. S. Qts., 8.75 Imp. Qts., 9,93 Liters

Anti-Freeze		Quantity of Anti-Freeze required for protection to:							
	Fahrenheit	+20°	+10°	0°	—10°	—20°	—30°	—40°	—50°
	Centigrade	—6.6	—12.2	—17.8	—23.3	—28.8	—34.4	—40	—45.5
Thermo-Royal	U. S. Qts.	2	3	4	4.5	5.5	6		
	Imp. Qts.	1.66	2.5	3.38	3.75	4.58	5		
	Liters	1,9	2,84	4	4,5	5,2	5,68		
Prestone	U. S. Qts.	2	3	3.5	4	4.5	5.5	6	6.5
	Imp. Qts.	1.66	2.5	2.91	3.38	3.75	4.58	5	5.4
	Liters	1,9	2,84	3,31	4	4,5	5,2	5,68	6,15
G. P. A.	U. S. Qts.	3.5	5	6.5	7.5	9	10.5		
Radiator	Imp. Qts.	2.91	4.14	5.4	6.25	7.5	8.35		
Glycerine	Liters	3,31	4,73	6,15	7,1	8,5	9,5		
Denatured Alcohol	U. S. Qts.	2	3	4	5	5.5	6.5	7	8
	Imp. Qts.	1.66	2.5	3.38	4.14	4.58	5.4	5.85	6.65
	Liters	1,9	2,84	4	4,73	5,2	6,15	6,5	7,5
Distilled	U. S. Qts.	2.5	3.5	4.5	5	5.5	6	6.5	7
Glycerine	Imp. Qts.	2.08	2.91	3.75	4.14	4.58	5	5.4	5.85
(Export Only)	Liters	2,5	3,31	4,5	4,73	5,2	5,68	6,15	6,5

ANTI-FREEZE CAPACITY CHART

Heavy Duty

Cooling System Capacity 13 U. S. Qts., 10.8 Imp. Qts., 12,3 Liters

Anti-Freeze		Quantity of Anti-Freeze required for protection to:							
	Fahrenheit	+20°	+10°	0°	—10°	—20°	—30°	—40°	—50°
	Centigrade	—6.6	—12.2	—17.8	—23.3	—28.8	—34.4	—40	—45.5
Thermo-Royal	U. S. Qts.	2.5	4	5	6	6.5	7.5		
	Imp. Qts.	2.08	3.38	4.14	5	5.4	6.25		
	Liters	2,5	4	4,73	5,68	6,15	7,1		
Prestone	U. S. Qts.	2	3.5	4.5	5.5	6	6.5	7.5	8.5
	Imp. Qts.	1.66	2.91	3.75	4.58	5	5.4	6.25	7.1
	Liters	1,9	3,31	4,5	5,2	5,68	6,15	7,1	8
G. P. A.	U. S. Qts.	4.5	6	8	9.5	11	13		
Radiator	Imp. Qts.	3.75	5	6.65	7.9	9.15	10.8		
Glycerine	Liters	4,5	5,68	7,5	9	10,3	12,3		
Denatured Alcohol	U. S. Qts.	2.5	4	5	6	6.5	7.5	9	10
	Imp. Qts.	2.08	3.38	4.14	5	5.4	6.25	7.5	8.35
	Liters	2,5	4	4,73	5,68	6,15	7,1	8,5	9,5
Distilled	U. S. Qts.	3	4.5	5.5	6	7	7.5	8.5	9
Glycerine	Imp. Qts.	2.5	3.75	4.58	5	5.85	6.25	7.1	7.5
(Export Only)	Liters	2,84	4,5	5,2	5,68	6,5	7,1	8	8,5

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COOLING DIAGNOSIS

EXCESSIVE ENGINE TEMPERATURES.

CAUSES

1. Ignition timing too late or too early.
2. Engine fan belt slipping.
3. Abnormal water loss from cooling system.
4. Radiator tubes restricted or clogged.
5. Radiator core surface restricted by license plate, emblems, etc.
6. Radiator core covered with heavy paint or dirt accumulation.
7. Engine thermostat not properly opening.
8. Engine thermostat reversed when installed.
9. Deteriorated or collapsed water pump inlet hose.
10. Pump impeller loose on shaft.
11. Abnormal clearance of impeller in pump housing.
12. Abnormal sludge or dirt accumulation in radiator or water jacket of engine block.
13. Any condition that will result in pre-ignition.
14. Spark modifier stuck and not advancing timing.
15. Restriction of water transfer holes in engine block or cylinder head.
16. *Cylinder head gasket improperly installed.*
17. Engine fan blades not set at proper pitch.
18. Foreign object such as wooden plug in cylinder head which floats and occasionally obstructs water circulation.
19. High frictional resistance in engine assembly resulting from:
    A. Insufficient internal clearance.
    B. Internal misalignment.
    C. Use of heavy engine oil.
    D. Insufficient oil circulation.
20. *Dragging brakes.*
21. Tight wheel bearings.
22. Abnormal frictional resistance in power transmitting units.
23. *Use of too fast a rear axle gear ratio or oversize tires in* mountainous areas.
24. Use of certain types of anti-freeze solutions in warm weather.

WATER LOSS FROM COOLING SYSTEM.

CAUSES

1. Radiator leaks.
2. Radiator or water pump hose leakage.
3. Cooling system drain plug or valve leakage.
4. Water pump leakage.
5. Cooling system gasket leakage.
6. Cylinder block or cylinder head cracked (leaking externally or internally).
7. Loose radiator upper tank baffle plate.
8. *Combustion gases leaking into cooling system because of* poor seal of cylinder head gasket due to faulty gasket or loose cylinder head cap screws.
9. Engine thermostat not functioning properly or operating without a thermostat.
10. Air leak occurring at water pump packing (loss at high speed only).
11. Engine overheating resulting in water boiling and loss through overflow pipe.

WATER PUMP NOISES.

DESCRIPTION

Water pump noises are rare and are often difficult to locate. However, a noisy water pump can generally be detected by the use of a sounding rod against the water pump body. Water pump noises are usually indicated by a scraping sound, squeal or bump, depending upon the type and conditions of the water pump.

CAUSES

1. Pulley loose on pump shaft.
2. Pump impeller loose on pump shaft.
3. Excessive end play of pump shaft.
4. Impeller blades rubbing water pump housing.
5. Impeller broken or pin sheared.

FAN NOISES.

DESCRIPTION

Fan noises due to a condition of the fan belt are usually apparent by a squeak or squeal in the forward part of the engine when the engine is idling or when the engine is rapidly accelerated.

Fan noises have various characteristics but can generally be located when the engine is idling. Paragraphs A, B and D under the following cause No. 2 will be indicated by a continuous squeak or squeal while paragraph A will cause an intermittent thud. Paragraph C causes a light metallic rattle at low speed with an uneven engine idle. The fan blades striking the radiator or fan belt will cause a decided scraping sound. Paragraphs F, G and H will generally cause a whir or hum at the higher engine speeds.

CAUSES

1. *Fan belt noises.*
    A. Belt adjusted too tight (squeak).
    B. Belt adjusted too loose (squeak on acceleration).
    C. *Grease, rust or foreign matter on fan belt or pulleys.*
    D. Incorrect type or make of fan belt.
    E. Fan belt badly worn or burned.
    F. *Misalignment of fan belt pulleys.*
2. Fan noises.
    A. Excessive fan shaft end play.
    B. *Fan blades loose on spider or hub.*
    C. Crankshaft, generator, accessory shaft or fan pulleys cracked or distorted.
    D. Fan hub loose and turning on shaft.
    E. Fan blades striking fan belt or radiator.
    F. Unbalanced fan blade assembly.
    G. Uneven pitch of fan blades.
    H. Bent or distorted fan blades.

PREMATURE FAN BELT BREAKAGE OR RAPID WEAR.

CAUSES

1. Tight adjustment causing abnormal stretch.
2. Loose adjustment causing excessive slippage.
3. Use of incorrect type belt.
4. Oil on belt causing deterioration.
5. Misalignment of belt pulleys.
6. Belt striking or rubbing on fan blades.
7. Excessive friction in water pump, generator or fan causing *overload on belt.*
8. Sustained high speeds.
9. Broken or rough fan pulley flanges.

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TRANSMISSION SECTION

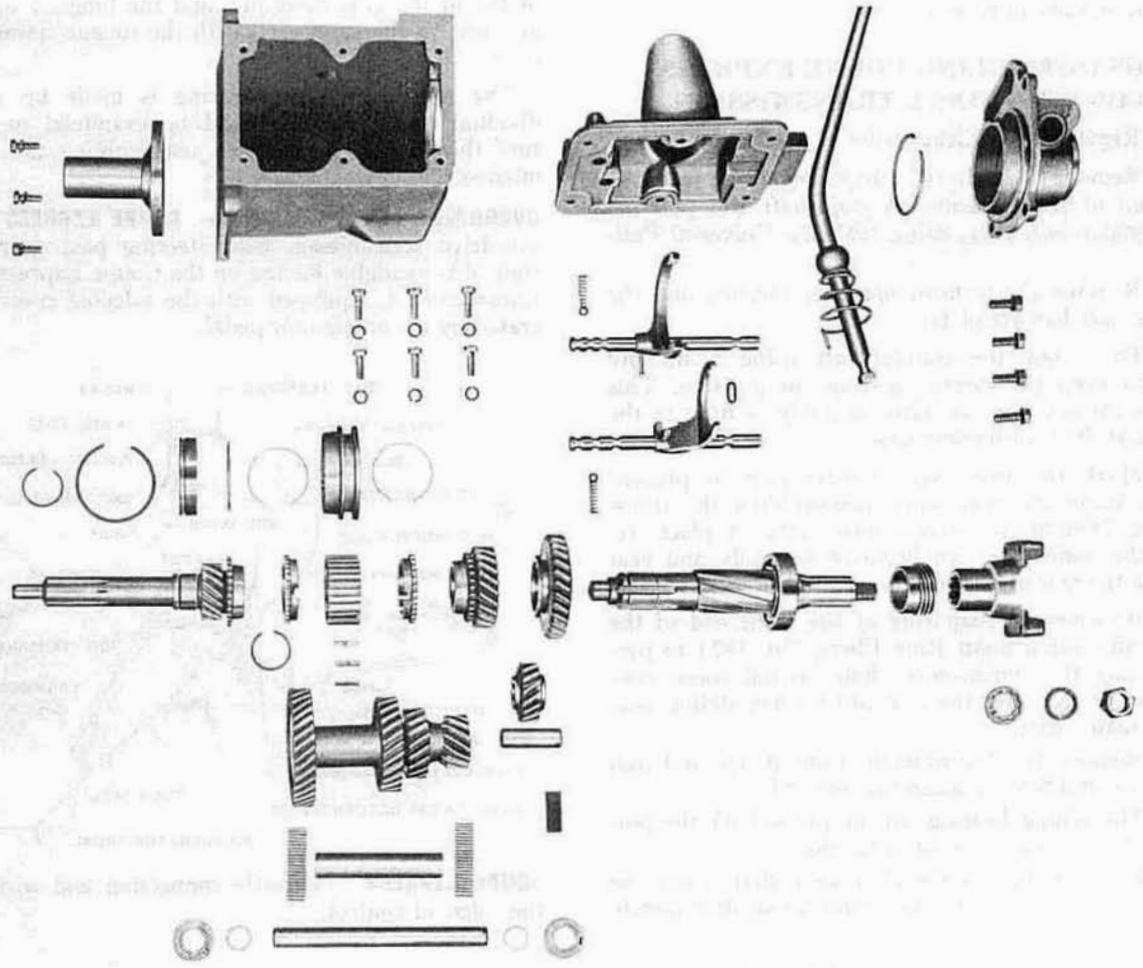
TRANSMISSION SPECIFICATIONS

	Std.	Special	Special	Std.
	Coupe Express	Coupe Express*	Coupe Express	Standard and Heavy Duty
Transmission Model	T90	T86-D	T9	T9
Torque Capacity—Lb. Ft.	160	180	180	180
Number of Speeds—Forward	3	3	4	4
Gear Ratio 1st	3.34-1	2.57-1	6.4-1	6.4-1
2nd	1.85-1	1.55-1	3.09-1	3.09-1
3rd	1-1	1-1	1.69-1	1.69-1
4th		7.22-1	1-1	1-1
Reverse	4.53-1	3.48-1	7.82-1	7.82-1
Oil Capacity—Pts.	2-1/2	4-1/2	6	6
Total Gear Reduction—Trans. 1st X Standard Rear Axle	16.098	12.35	30.8	35.648
Countershaft Front	Roller	Bantam Roller	Roller	Roller
Countershaft Rear	Roller	Bantam Roller	Roller	Roller

*Overdrive and Remote Control.

TRANSMISSION SERVICE TOOLS

187	Snap Ring Removing Pliers	J-1526	Transmission Pinion Thrust Yoke
J-1298	Transmission Front Bearing Puller Plate	J-1308-A	Shift Rod Adjusting Gauge
HM-925	Utility Puller Set		



Parts of the Coupe Express Conventional Transmission.

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GENERAL

ALL MODELS There are times when a transmission should be replaced in preference to repairing it. The following procedure is recommended as a guide in determining procedure to follow:

1. A transmission *which is within the warranty* may be replaced with a new one. Credit will be allowed for the old one unless damaged by abuse or neglect.

2. On "M" Series vehicles which are not within the warranty, write to the General Service Department describing the difficulty and include information regarding type of transmission, car model, serial number, date of purchase, mileage, etc. Prompt recommendations will be sent regarding repairs or replacement.

3. Transmissions on Coupe Express models should be repaired only when service men are sure of their diagnosis and the dealer is willing to guarantee the work. Information regarding a special exchange price can be had by writing to the General Service Department, giving complete information.

Note to Export Dealers: The above information applies to United States Dealers only.

Conventional and overdrive transmissions, used in all Coupe Express models, provide three speeds forward and one in reverse. As optional equipment, a four speed transmission can be obtained at extra cost for the Coupe Express. In all Standard and Heavy Duty models the standard transmission has four speeds forward and one in reverse.

DISASSEMBLING COUPE EXPRESS CONVENTIONAL TRANSMISSION

1. Remove the shifting lever tower assembly.

2. Remove the 1-1/16" (26,99 mm) nut from the rear end of the transmission mainshaft and pull the rear companion flange, using HM-925 Universal Puller.

3. Remove the transmission rear housing and the countershaft locking plate.

4. Drive out the countershaft using a dummy shaft to keep the needle bearings in position. This permits the countershaft gear assembly to drop to the bottom of the transmission case.

5. Mark the front synchronizer ring to prevent placing it on the rear when reassembling the transmission. Holding the synchronizer ring in place, remove the mainshaft, synchronizer assembly and gear through the rear of the housing.

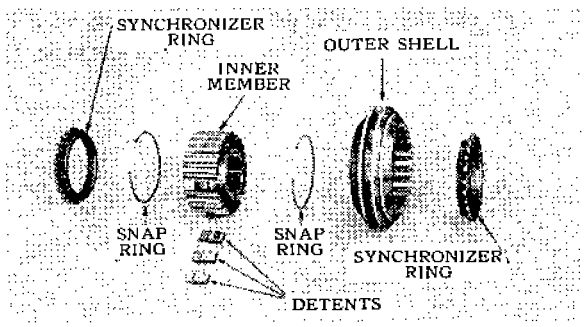
6. Remove the snap ring at the front end of the mainshaft (using Snap Ring Pliers, No. 187) to permit sliding the synchronizer hub, second speed constant mesh gear and the low and reverse sliding gear off the main shaft.

7. Remove the transmission front flange and pull the pinion and bearing assembly forward.

8. The pinion bearing can be pressed off the pinion shaft after removing the snap ring.

9. Remove the reverse idler gear shaft from the front of the transmission case, using a long drift punch.

10. Remove the countershaft gear assembly from the transmission case, taking care not to lose the needle bearings from the ends of the gear.



NOTE: Thoroughly clean all parts before reassembling.

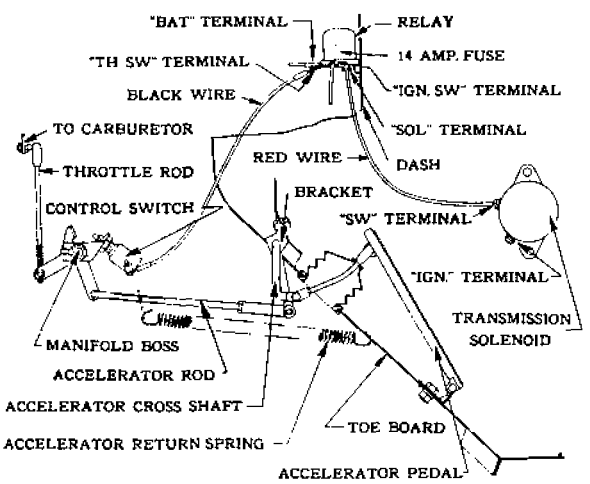
To reassemble the transmission the preceding operation steps can be reversed. The following points, however, must be given attention:

When assembling the synchronizer unit on the mainshaft, make sure that the long ends of the inner and outer members are toward the front of the transmission.

When installing the countershaft and bearing assembly, use a dummy shaft and make sure that the needle bearings and bearing spacer are in their proper position; that the ring washers are placed at each end of the of the gear assembly, and the tongued washers are next to the case, each with the tongue toward the case.

The mainshaft front bearing is made up of individual rollers which should be examined to make sure they are in place when reassembling the transmission.

OVERDRIVE TRANSMISSION — COUPE EXPRESS An overdrive transmission with steering post gear shift control is available for use on the Coupe Express. This transmission is equipped with the solenoid control operated by the accelerator pedal.



COUPE EXPRESS Throttle connection and wiring of the solenoid control.

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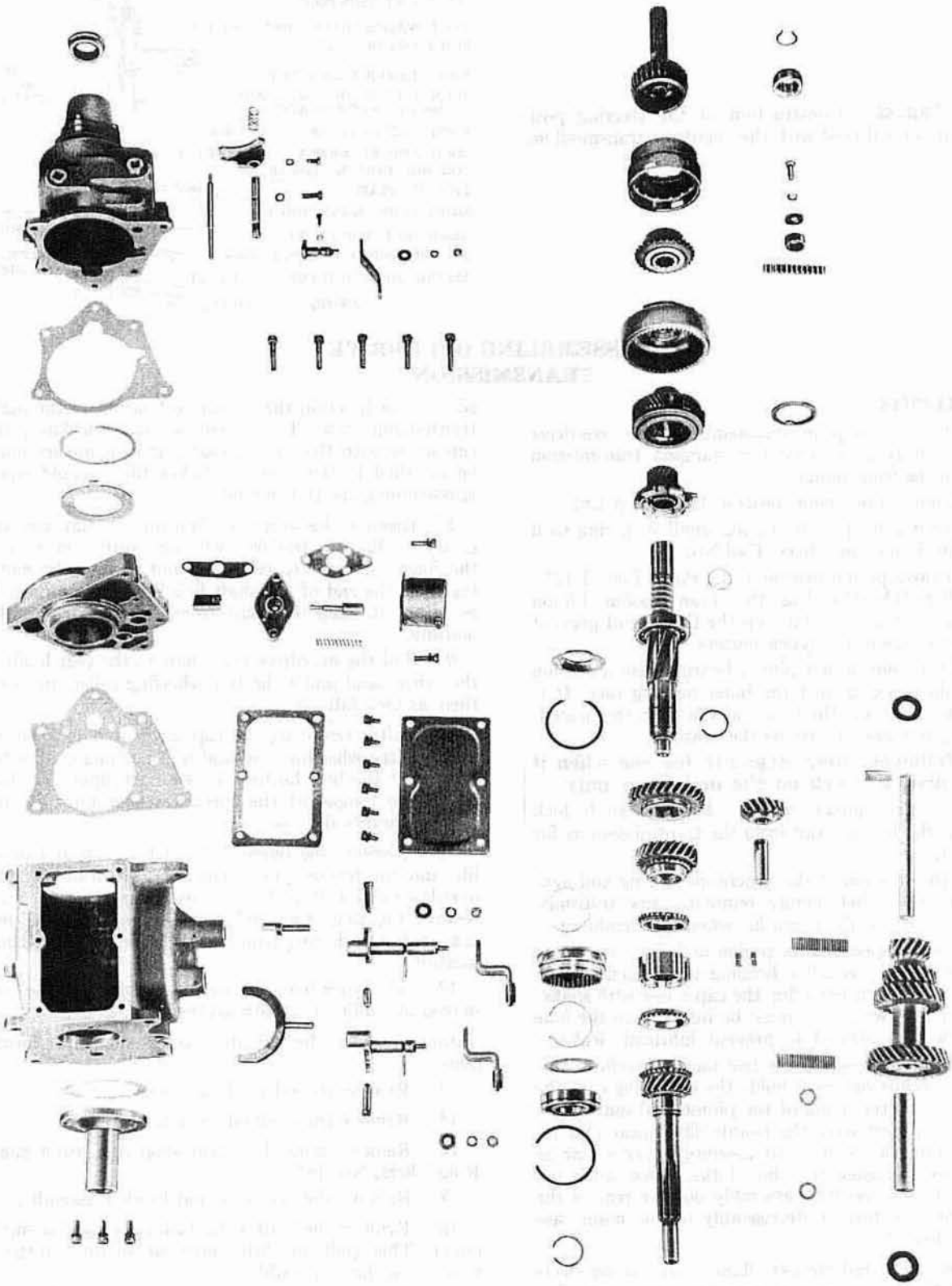

Exploded view — Overdrive Transmission.

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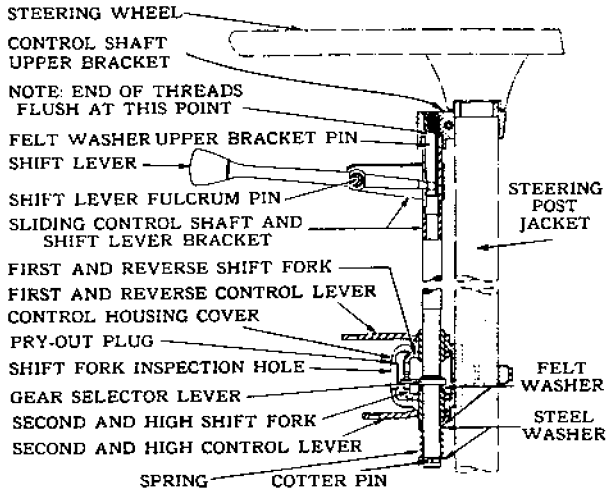

COUPE EXPRESS Construction of the steering post gear shift control used with the overdrive transmission.

DISASSEMBLING OVERDRIVE TRANSMISSION

COUPE EXPRESS

1. The first step in disassembling the overdrive transmission is to remove the stamped transmission cover and the front flange.

2. Remove the pinion bearing large snap ring.

3. Remove the pinion bearing small snap ring with Snap Ring Removing Pliers, Tool No. 187.

4. Remove pinion bearing using Puller Plate J-1298 and Puller HM-925. Use the Transmission Pinion Thrust Yoke J-1526 to take up the thrust and prevent possible damage to the synchronizers.

5. When reinstalling pinion bearing, use a section of pipe thrusting against the inner bearing race. It is also advisable to use the tools mentioned in the preceding paragraph when replacing the bearing.

The following four steps are for use when it it is desired to work on the main case only:

With a small punch remove the shift shaft lock pins. Pull the levers away from the transmission as far as possible.

Mark the relation of the synchronizer ring and synchronizer outer shell before removing any transmission gears. Align these marks when reassembling.

Remove the speedometer pinion and five cap screws which retain the overdrive housing to the main transmission case. When replacing the cap screw with shake-proof star lock washer, it must be installed in the hole just below the solenoid to prevent lubricant leakage.

It is usually necessary for two men to perform this operation. While one man holds the overdrive case the other can cock the angle of the pinion and main shaft raising the pinion over the countershaft gear and remove it. Pull the main shaft assembly over as far as possible to disengage the shift forks. Then work the main shaft and overdrive assembly out the rear of the main case. For further disassembly of the main case see operation 23.

6. Remove overdrive case flange and remove overdrive shaft rear snap ring using Snap Ring Removing Pliers, No. 187.

7. Remove the speedometer pinion and five cap screws which retain the overdrive housing to the main transmission case. To prevent lubricant leakage, the cap screw with the shake-proof star lock washer must be installed in the hole just below the solenoid when reassembling the transmission.

8. Remove the overdrive housing. It may be necessary to line up the free wheeling shifter case with the finger in order to release it and remove the housing. Tap the end of the shaft lightly with a hammer if necessary to keep the shaft from coming off with the housing.

9. Pull the overdrive rear shaft to the rear holding the other hand under the free wheeling rollers to catch them as they fall out.

10. After removing the cap screw and lock washers, the free wheeling cam and hub bushing can be removed. If the hub bushing is removed, upon reinstallation the tongue of the special washer must be installed towards the cam.

11. Remove the overdrive clutch and gear assembly and the bronze pinion cage thrust washer. If the overdrive clutch is to be removed from the ring gear, remove the snap ring and paint a mark on the ring gear and clutch to permit reassembling in the same location.

12. The overdrive pinion assembly can be removed by pulling it off toward the rear.

13. Remove the adapter snap ring and thrust plate.

14. Remove the solenoid (2 screws).

15. Remove the solenoid pawl and plunger.

16. Remove main shaft rear snap ring using Snap Ring Pliers, No. 187.

17. Remove the sun gear and blocker assembly.

18. Remove the shift shaft lock pins using a small punch. Then pull the shift shafts out of the transmission case as far as possible.

19. Mark the front synchronizer ring and the synchronizer outer shell before removing any transmission gears. When replacing the synchronizer rings, make

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sure the marked one is in front and the other in the rear.

20. Use a screwdriver or similar tool to pry off the adapter plate. Always install new gaskets when reassembling.

21. To remove the pinion, cock the angle of the pinion and main shaft, raise the pinion over the countershaft gear and pull it out the front of the transmission case.

22. Pull the main shaft over as far as possible to disengage the shift forks. Then, work the main shaft and gear assembly out the rear of the main case.

23. *After removing the main shaft snap ring, the* synchronizer and main shaft gear can be slid off the main shaft.

24. To remove the main shaft from the adapter plate, remove the large lock ring to release the mainshaft bearing.

25. Take out the countershaft lock. Use a dummy shaft, 6-5/16″ x 3/4″ (160,34 x 19,05 mm), to keep the roller bearings in place. The reverse idler shaft can be driven out toward the rear. A ring washer is placed at either end of the countershaft bore, and a tongued washer next to the case at both ends with the tongue toward the case.

26. After loosening the overdrive shift lever lock screw and removing the overdrive shift control lever, the overdrive shift lever and shaft can be removed.

27. To remove the overdrive shift yoke, back out *the lock screws, remove the plug and loosen the re*taining screw using a wrench.

28. Remove the shift shaft fork and spring.

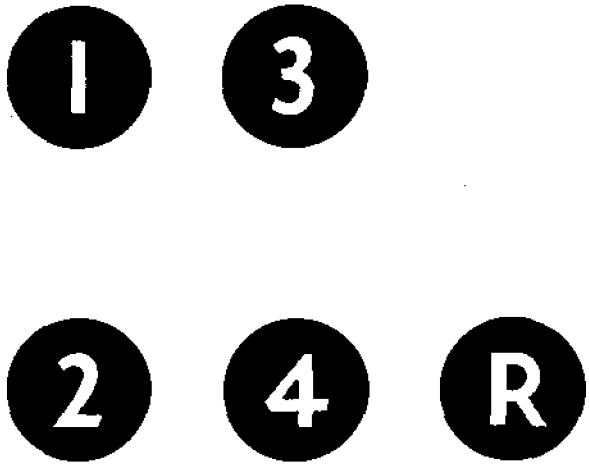
FOUR SPEED TRANSMISSION

The *four-speed transmission* is mounted as a unit with the engine, and is of selective sliding gear type, having four speeds forward and one in reverse. The transmission is piloted into the bore of the clutch housing by the transmission case front flange and is securely held against the face of the clutch housing by four cap screws. The clutch housing is held in proper alignment with the engine crankshaft by means of four dowel bolts (two on each side) which are inserted through the flanges of the clutch housing and rear engine plate. Shift gears into the second speed position for ease of removing or installing control cover. Care should be exercised in the removal or installation of ball bearings. Pounding on the outer race is sure to injure the bearings. Use a hollow mandrel and bearing puller.

Gear ratios are as follows:

Reverse 7.82 to 1 First 6.41 to 1 Second 3.09 to 1
Third 1.69 to 1 High 1 to 1

A standard large size S. A. E. opening is provided on the right side of the transmission case for power take-off installation.



• Shifting Lever Positions — 4-Speed Transmission.

DISASSEMBLY — FOUR SPEED TRANSMISSION

To disassemble the four speed transmission:

1. Remove the four cap screws holding the shifting tower to the transmission case and remove the shifting tower.

2. Remove the front flange and gasket.

3. Pull the pinion and bearing forward from the case.

4. Remove the rear flange.

5. Drive the mainshaft rearward out of the case, stripping the gears off the shaft as it is removed.

6. Press the mainshaft out of the bearing.

7. Remove the cotter pin from the reverse idler shift shaft and drive the shaft rearward out of the case.

8. Remove the cap screw and lock plate between the countershaft and reverse idler shaft.

9. Drive out the countershaft toward the rear and remove the gear cluster.

10. Engage the end of a pinch bar or crow bar in the lock notch of the reverse idler shaft. Using the transmission case as a fulcrum, drive on the other end *of the bar with a heavy hammer until the shaft loosens* enough to be drawn from the case. Remove the reverse idler gear cluster.

Reassemble the transmission by reversing the preceding operations. Replace all gaskets with new ones.

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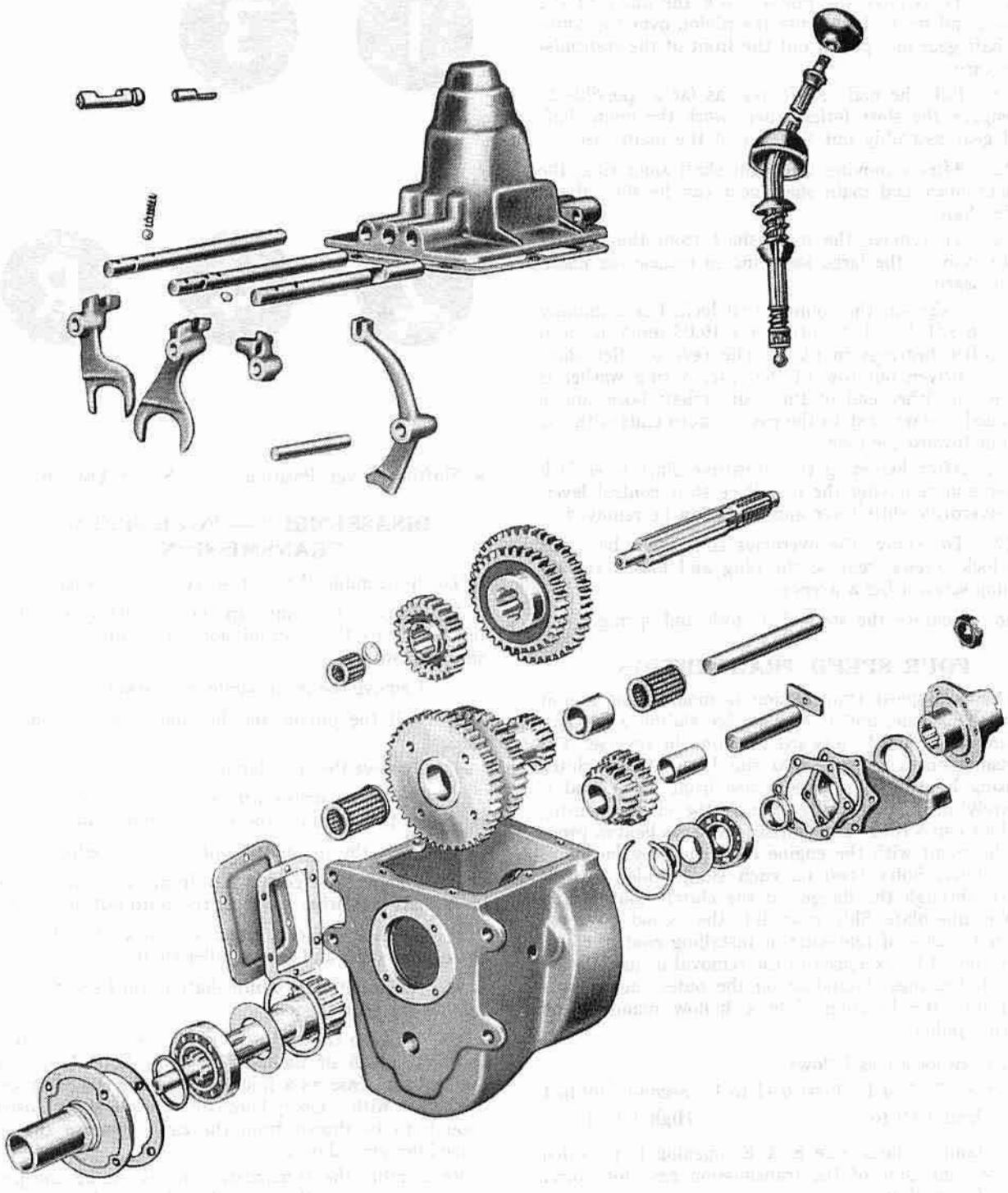

All Models.

Parts of the 4-speed conventional transmission in the order of their assembly. (The four speed transmission should not be confused with overdrive, which is used only with the three speed conventional transmission Coupe Express models.)

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TRANSMISSION DIAGNOSIS

TRANSMISSION NOISY IN NEUTRAL.

DESCRIPTION

Transmission noises in neutral, when the engine is idling, can generally be classified as a hiss or growl. Bearing difficulty is generally apparent as a hiss although in severe cases a bump or thud will be heard. Rough, worn, chipped or scuffed gears are apparent as an intermittent growl or hum. An out of alignment condition between the transmission and the engine assembly will cause a grind after the transmission has been in service for some time.

CAUSES

1. Misalignment of transmission with engine assembly.
2. Transmission pinion bearing worn, rough or dirty.
3. Transmission constant mesh gears worn, scuffed, chipped, burred or improperly machined.
4. Transmission countershaft bushings scored, worn, dirty or rough.
5. Transmission second speed main shaft gear bushing rough, scored or badly worn.
6. Transmission constant mesh gears not properly meshed or matched.
7. Replacement of but one constant mesh gear instead of the complete set.
8. Reverse idler gear shaft or bushing rough, scored or worn.
9. Reverse idler gear worn, scuffed, chipped, burred or improperly machined.
10. Eccentric countershaft gear assembly.
11. Countershaft sprung or badly worn.
12. Eccentric second speed constant mesh gear.
13. Too much lash in constant mesh gear train.
14. Abnormal end play of countershaft gear, reverse idler gear or pinion.
15. Transmission main shaft pilot bearing badly worn or broken.
16. Insufficient lubricant in transmission.
17. Incorrect grade or poor quality of transmission lubricant.

TRANSMISSION NOISY IN GEAR — OVERDRIVE OR CONVENTIONAL.

DESCRIPTION

Most transmission noises apparent in neutral will also be noticed in gear, although the frequency of the noise will increase. Transmission noises due to engine torsional periods occur at definite speeds and are not apparent throughout the entire speed range. Torsional transmission noises are usually a high pitched, high frequency, metallic rattle.

CAUSES

1. Conditions causing noise in neutral — usually more pronounced at low road speeds.
2. Engine torsional periods being transmitted to transmission:
   A. Clutch plate mechanical damper inoperative or improperly adjusted.
   B. Clutch plate mechanical damper springs weak or broken.
3. Transmission main shaft rear bearing rough, worn or dirty.
4. Transmission sliding gear teeth rough, worn, burned, scuffed, pitted, chipped or tapered.
5. Excessive clearance or end play of second speed main shaft gear on main shaft.
6. Transmission clutch noise — free wheeling only.
7. Noisy speedometer gears.

TRANSMISSION OIL LEAKS.

CAUSES

1. Lubricant level too high in transmission case.
2. Damaged, improperly installed or missing gaskets.
3. Damaged or improperly installed oil seals.
4. Damaged, improperly installed or missing oil throw rings.
5. Transmission case plugs loose or threads damaged.
6. Transmission case bolts loose, missing, or threads stripped.
7. Sand hole or crack in transmission case or cover.
8. Use of a lubricant which foams excessively.

TRANSMISSION — DIFFICULT SHIFTING INTO GEAR.

CAUSES

1. Failure to completely release engine clutch.
2. Engine clutch spinning or sticking on splined pinion shaft.
3. Sliding gear tight on main shaft splines.
4. Insufficient chamfer of sliding gear teeth.
5. Main shaft splines distorted, burred or otherwise damaged.
6. Synchronizing unit outer sleeve fits too tightly on synchronizer hub.
7. Improper adjustment of remote control linkage.

TRANSMISSION STICKING IN GEAR.

CAUSES

1. Engine clutch not completely released.
2. Insufficient chamfer at edge of gear shift lever detent ball notches.
3. Sliding gear tight on main shaft splines.
4. Distorted, burred or otherwise damaged main shaft splines.
5. Improper adjustment of remote control linkage.

TRANSMISSION — SLIPPING OUT OF HIGH GEAR.

CAUSES

1. Misalignment of transmission with engine assembly.
2. Transmission pinion gear teeth worn or tapered.
3. Clutch sleeve gear teeth worn or tapered.
4. Insufficient spring tension on gear shift lever detent ball notch.
5. To much chamfer on edge of gear shift lever detent ball notches.
6. Improper adjustment of remote control linkage.

TRANSMISSION — SLIPPING OUT OF SECOND GEAR.

CAUSES

1. Abnormal clearance between second speed constant mesh gear and main shaft.
2. Abnormal end play of second speed constant mesh gear on main shaft.
3. Second speed clutch gear teeth worn, tapered or distorted.
4. Too much chamfer on edge of gear shift lever detent ball notch.
5. Insufficient gear mesh.
6. Improper adjustment of remote control linkage.

TRANSMISSION — SLIPPING OUT OF FIRST OR REVERSE GEAR.

CAUSES

1. First and reverse sliding gear loose on main shaft splines.
2. First and reverse sliding gear teeth worn or tapered.
3. Main shaft splines worn or distorted.
4. Countershaft first speed gear worn or tapered.
5. Excessive end play of countershaft in transmission.
6. Reverse idler gear teeth worn or tapered.
7. Excessive end play of reverse idler gear in transmission case.
8. Insufficient gear mesh.
9. Too much chamfer on edge of gear shift lever detent ball notch.
10. Gear shift lever lock ball notch not machined sufficiently deep.
11. Improper adjustment of remote control linkage.

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CLUTCH SECTION

GENERAL

• The single-plate, dry-disc type clutch is used in all models. There is no adjustment for wear provided in the clutch itself. An individual adjustment is provided for each release lever in manufacture, but the adjusting nut is locked in position, and should never be disturbed unless the clutch is dismantled for the replacement of parts.

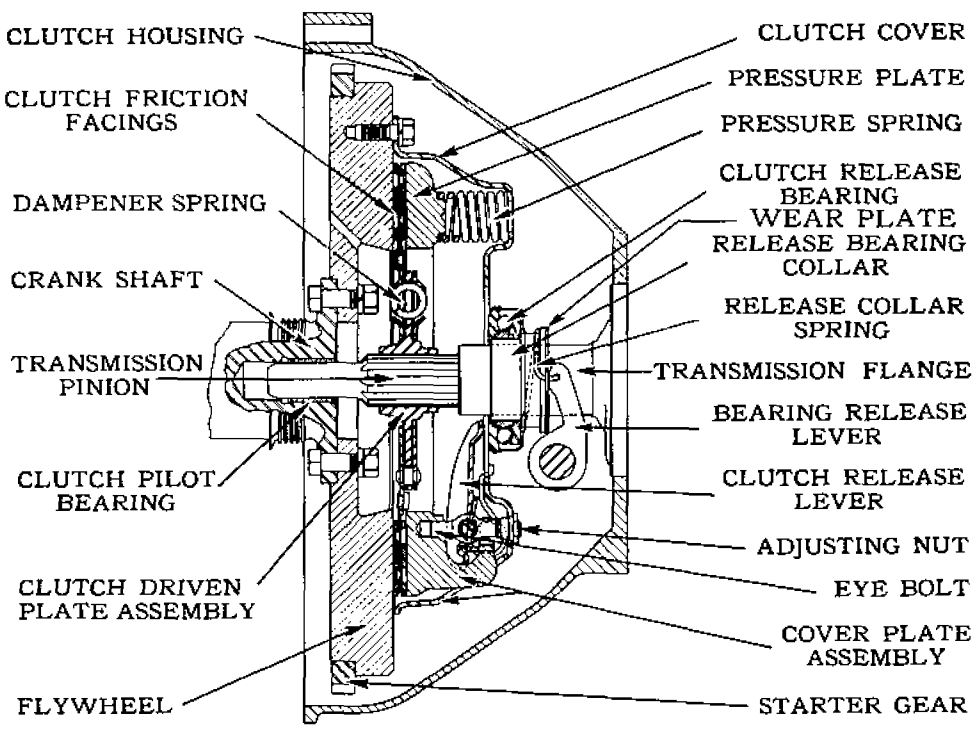
The action of the Heavy Duty clutch pressure plate spring is such that pressure exerted upon the clutch plate will increase as the driven disc becomes worn. A ball bearing pre-lubricated clutch release bearing, combined with the wear plate, is used in all clutches.

CLUTCH SPECIFICATIONS

	Coupe Express (M5)	Standard (M15)	Heavy Duty (M16)
Make	Borg & Beck	Borg & Beck	Inland
Model	9A6	9A6	G
Torque—Ft. Lbs.	175	175	225
Type	Single Plate Dry Disc.	Single Plate Dry Disc.	Single Plate Dry Disc.
Vibration Damper	Yes	Yes	Yes
Number of Driving Discs	2	2	2
Number of Driven Discs	1	1	1
Facing—Inside Diameter	6″	6″	7″
Facing—Outside Diameter	9-1/4″	9-1/4″	10-3/4″
Facing Thickness	1/8″	1/8″	.140″
Number of Facings	2	2	2
Is Clutch Adjustable	Yes	Yes	Yes
Throwout Bearing Size or Number	A-899-2	A-899-2	CTL-54
Throwout Bearing Lubrication	Pre-Packed	Pre-Packed	Pre-Packed
Number of Pressure Springs	9	9	1 Disc.
Total Spring Pressure on Plate	1215#	1215#	1350-1450#

CLUTCH SERVICE TOOLS

S-196 Dial Test Indicator F-6A Clutch Aligning Arbor



Construction of Coupe Express and Standard Clutch.

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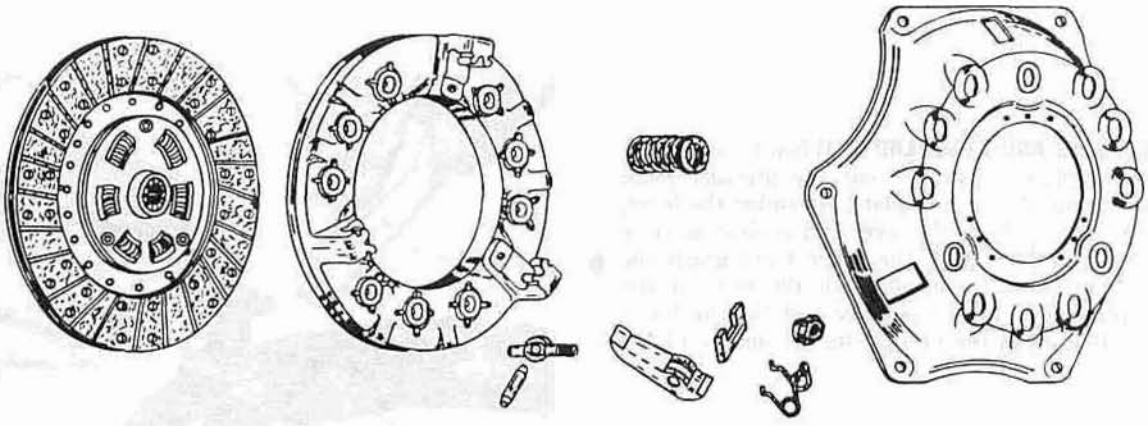
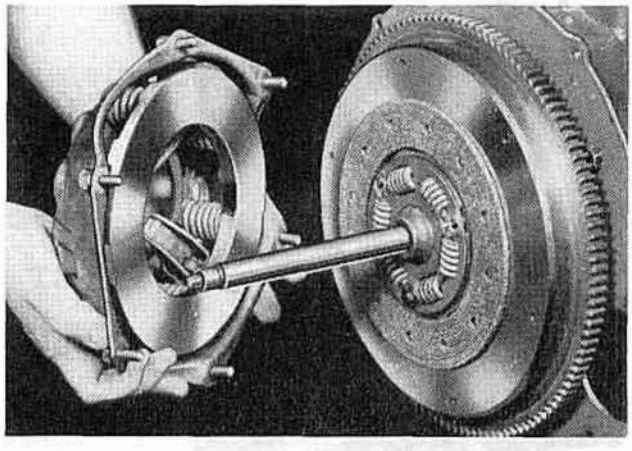


Parts of the Coupe Express and Standard Clutch.

COUPE EXPRESS AND STANDARD The clutch pedal should have a minimum of 1″ (25,4 mm) free travel before the resistance of the release mechanism can be felt. If there is less than 1″ (25,4 mm) of free pedal travel, turn the clutch lever adjusting sleeve located in the rod linking the pedal to the shaft lever.

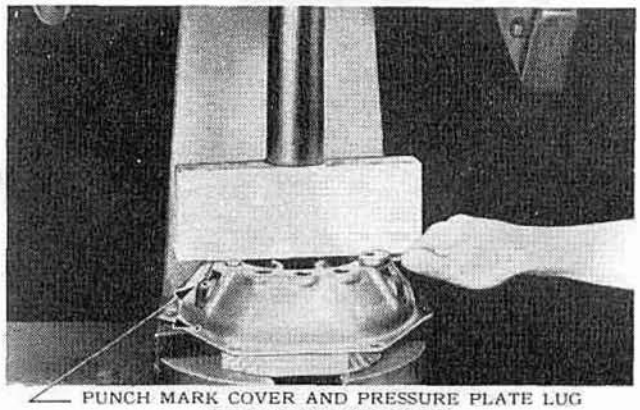
CLUTCH REMOVAL OR INSTALLATION



COUPE EXPRESS AND STANDARD It is necessary to remove only six screws to take the clutch assembly from the flywheel. To replace the clutch assembly on the flywheel, it is necessary to use the clutch aligning gauge, F-6A. Slip the clutch driven member over the aligning gauge until it fits tightly against the flywheel. It should be installed with the driving hub side away from the flywheel. Place a 3/8″ (9,52 mm) wood block between each release lever and the rim of the clutch cover. This will prevent pressure plate distortion during the installation. Then fasten the clutch assembly to the flywheel, tightening all cover bolts down evenly. The cap screws should be snugged down in sequence before the final tightening to avoid distorting the cover.

DISASSEMBLING PRESSURE PLATE

COUPE EXPRESS AND STANDARD Before disassembling the cover plate assembly, a hacksaw should be used to break away the seal of the release lever adjusting nuts. Place a punch mark on the cover and on a pressure plate lug. By removing the metal of the adjusting nut which has been upset into the slot in the eyebolt, the operation of unscrewing the three release lever adjusting nuts is greatly aided. Place the pressure plate assembly on the bed of an arbor press with a wood block under the pressure plate, so arranged that the cover is left free to move down. Place a wood block across the top cover, resting on the spring bosses. Compress the assembly with the press and remove the adjusting nuts. Slowly release the press to prevent the springs from flying out.



PUNCH MARK COVER AND PRESSURE PLATE LUG BEFORE DISASSEMBLING

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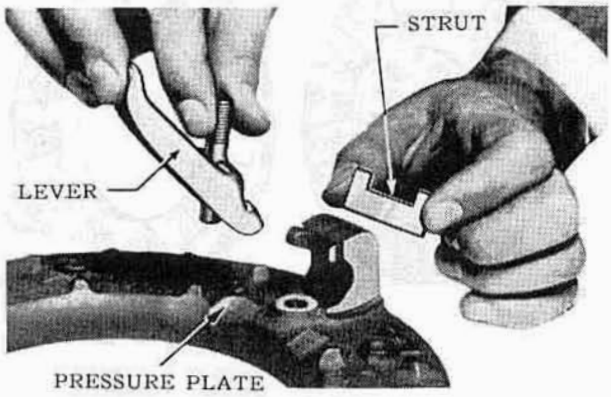
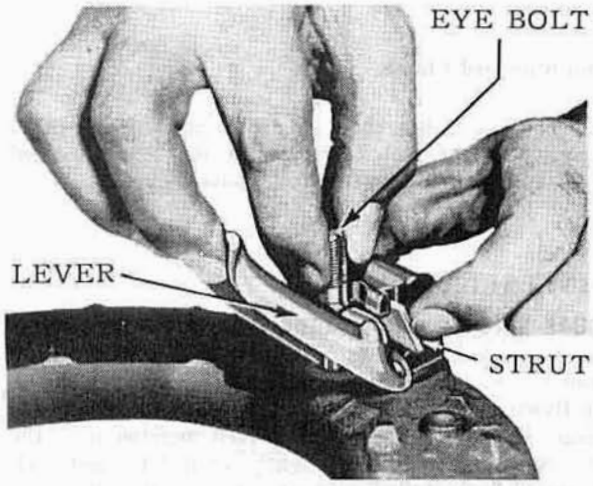
REASSEMBLING PRESSURE PLATE

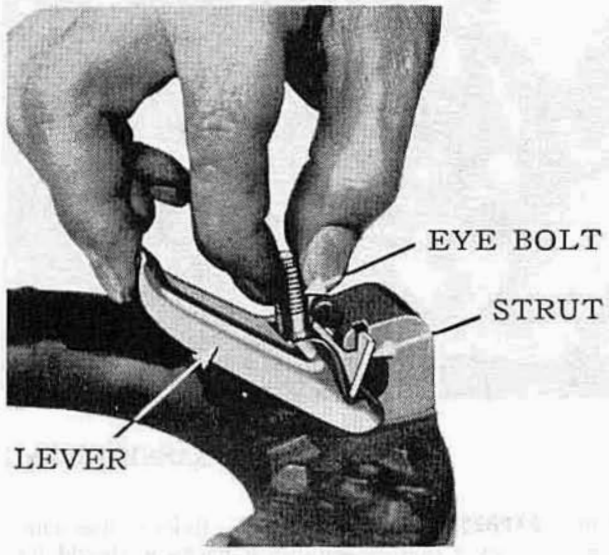
COUPE EXPRESS AND STANDARD When reassembling the pressure plate assembly, coat the pressure plate lugs with a thin film of lubriplate. Assemble the lever, eyebolt and pin, holding the lever and eyebolt as close together as possible. With the other hand grasp the strut as shown. Insert the strut in the slots of the pressure plate lug, drop it slightly and tilt the lower edge until it touches the vertical milled surface of the lug.

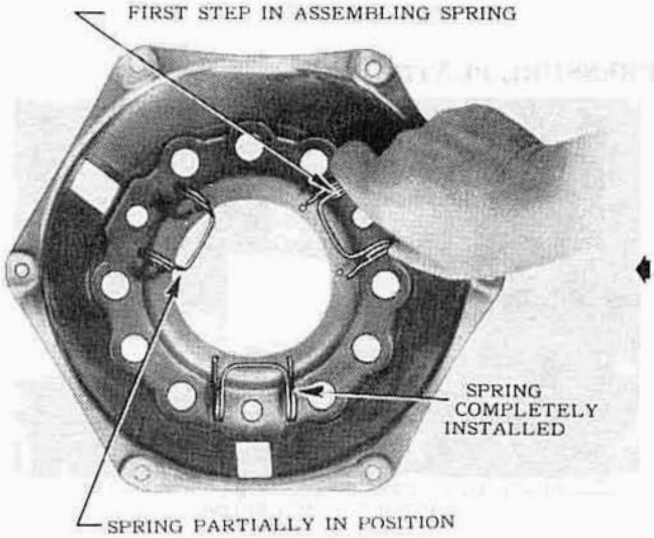




COUPE EXPRESS AND STANDARD Insert the lower end of the eyebolt in the hole in the pressure plate. The short end of the lever will then be under the hook of the pressure plate and near the strut.

COUPE EXPRESS AND STANDARD Slide the strut upward in the slots of the lug, lifting it over the ridge on the short end of the levers while dropping it into the groove in the lever.





COUPE EXPRESS AND STANDARD Assemble the lever return springs in the cover.

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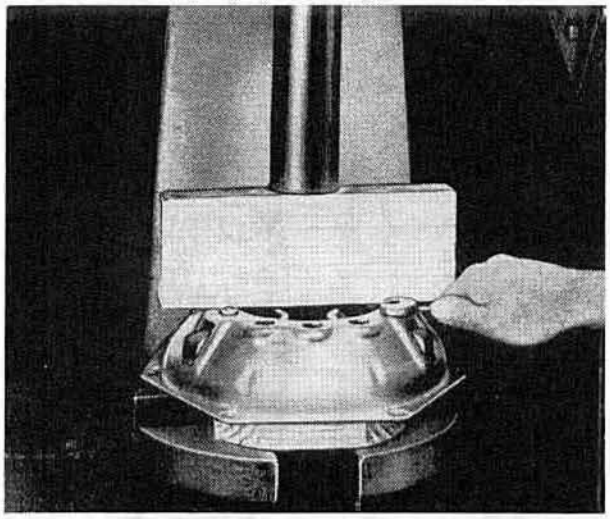
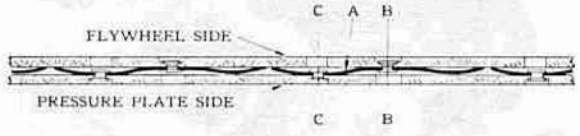
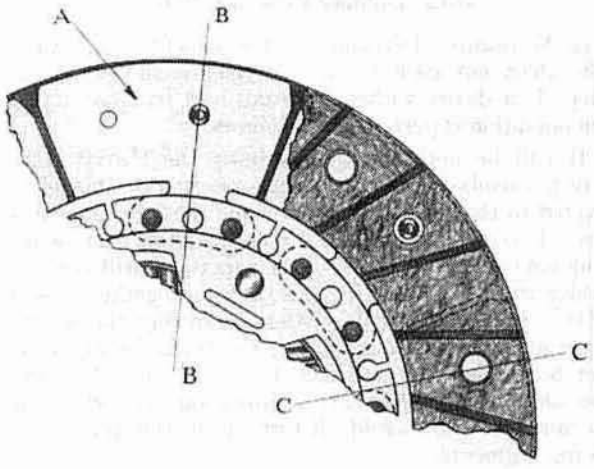


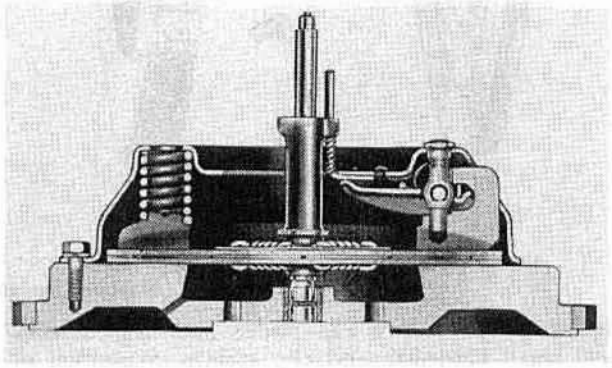
COUPE EXPRESS AND STANDARD Place the driven member on the flywheel and install the clutch aligning arbor F-6A in the flywheel pilot bearing and hub driven member. Make sure the arbor is centered properly and locked tightly in place. Mount the cover assembly on the flywheel. Tighten the cover retaining screws only a turn or two at a time when pulling against the pressure of the springs to avoid distorting the cover. Depress each lever several times with a hammer handle to settle all parts into their proper positions.





Driven Plate Construction.

COUPE EXPRESS AND STANDARD Lay the cover on top of the pressure plate and assembled parts. Be sure the punch marks on the cover and pressure plate are matched to maintain proper balance. Slowly compress the cover and make sure the eyebolts and pressure plate lugs are guided through the proper holes in the cover. Hold the clutch under compression and screw down the adjusting nuts until they are flush with the top of the eyebolts. Then release the press.



COUPE EXPRESS AND STANDARD Turn the clutch lever adjusting nut as required until the lever is flush with the finger of the adjusting gauge. Adjust the height of the other levers in the same manner. After adjusting the lever height, stake the nuts with a dull punch. The nut metal should be driven into eyebolt grooves to provide a secure lock.

COUPE EXPRESS AND STANDARD Other than replacing the friction facings, no reconditioning of the driven plate assembly is recommended. To prevent damage or distortion of the plate, in removing the old facings, the rivets must be drilled and not punched out. Use a 3/16″ (4,8 mm) drill.

To replace the facing, place it on the flywheel side of the driven plate, with countersunk holes lined up with rivet holes in the cushion spring "A" as shown in Section "B-B" at the left, and resting on the cushion spring which is convex at this point. Rivet each cushion spring to this facing before installing the other facing. Roll the rivets against cushion spring "A" — do not split them.

Turn the driven plate over and line up the countersunk holes of the pressure plate facing with the holes in the cushion spring as shown in Section "C-C." Insert the rivet head in the counter bore and roll, not split, against the cushion spring "A."

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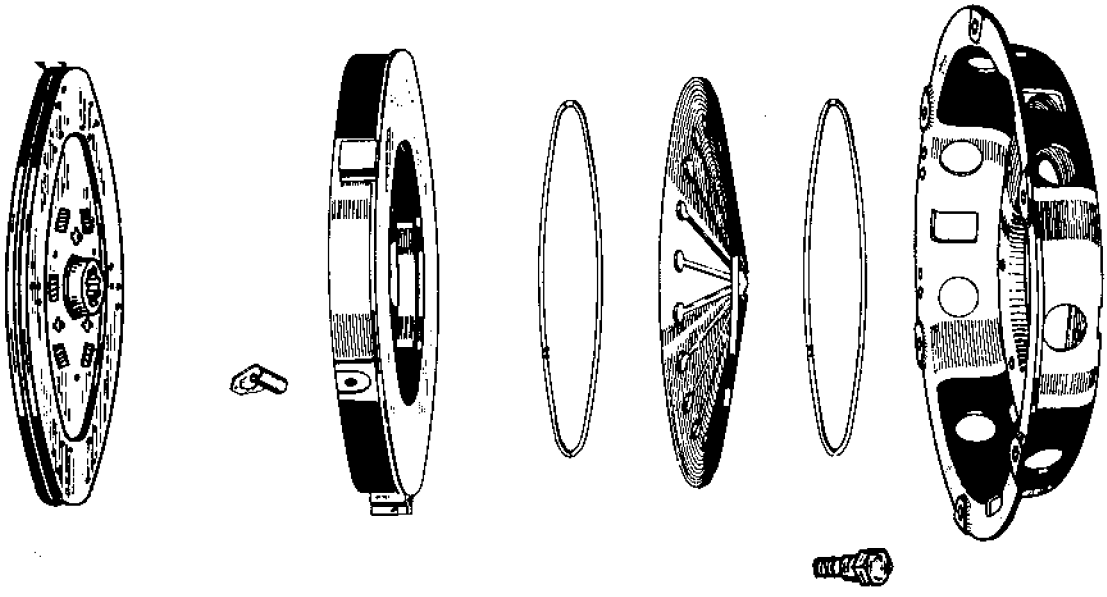
HEAVY DUTY CLUTCH



Parts of the Heavy Duty Clutch.

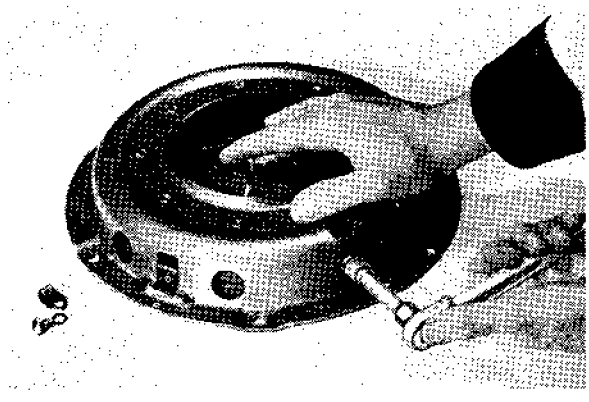
HEAVY DUTY Three cap screws and lock washers hold small hardened steel clip springs in position to insure the pressure plate following the spring when the clutch is released. The action of the single-disc type clutch spring is such that pressure exerted upon the clutch plate will increase as the driven disc becomes worn. The adjustment for wear is made through the clutch adjusting link nut located on the rod linking the pedal to the shaft lever. The clutch pedal at all times should have a minimum of 1″ (25,4 mm) of free travel before the resistance of the release mechanism can be felt. If less than 1″ (25,4 mm) of free travel exists, back off the adjusting nut until at least 1″ (25,4 mm) of free pedal travel is secured. If there is no free pedal travel, the clutch may slip, resulting in damage to the facings and the release bearing.

HEAVY DUTY Remove the pressure plate by removing the three screws and tension springs through the slots provided for this purpose in the clutch cover. CAUTION! *After the three spring clips have been removed, hold the cover inverted with hands over the pressure plate to prevent it from falling on the bench or floor with resultant damage.* Since the clutch disc spring is not available as a separate part, the rivet which holds the spring to the cover should not be broken and no attempt should be made to remove the spring for service.

HEAVY DUTY When the original units are reassembled, be sure the mark "O" on one of the driving lugs of the pressure plate coincides with the mark "O" on the flange of the clutch cover. Observe this precaution for balancing purposes.

Ordinarily, the clutch driven member assembly in the Heavy Duty will require no service other than replacement of the friction linings.

Completely reconditioned clutch driven member assemblies are available through the Studebaker Parts and Accessories Division for the benefit of a dealer who does not care to service the assemblies in his shop. If a dealer wishes to install new friction facings the operation is performed as follows:



Disassembling Pressure Plate.

It will be noted from examining the Heavy Duty driven member assembly that one friction facing is riveted to the spring segments while the other facing is riveted to the main plate. Because of this fact, when removing the facings, the first step is to drill out the twelve iron rivets holding the sections together (use a 3/16″ (4,8 mm) drill). After separating the spring segments from the main plate, the brass facing rivets can be drilled out with a 3/16″ (4,8 mm) drill and the old facings removed. Drilling out the rivets is recommended to avoid distortion of the plate and spring segments.

When installing new friction facings, assemble each spring plate segment to the facing in such a manner that the clearance at the outer circumference of the assembly is between the center portion of the spring plate and the facing. The center portion of each spring

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plate will then bear against the main plate, when the assembly is completed. The rivets in both facings should be installed with the rivet heads in the facing counter bores, so that riveting is done on the plate or spring plate sides of the assemblies.

The friction facings will clear the twelve holes for the iron rivets when properly installed on the main plate and on the spring plate. These holes are aligned in pairs radially from the hub center. The friction facing rivet holes are staggered and can be identified by this fact.

It is recommended that rivets used by the factory be obtained and used for assembling friction facings and plates. Use a riveting tool. During the riveting operation make sure that the new friction facings are held tightly against the plates. This is important because clutch drag will result from facing unparallelism due to poor riveting.

Oil or grease on friction facings causes clutch chatter and grab during the engagement period and possible slippage at higher speeds. When this condition exists, check the source of leakage and correct it. A clean cloth saturated with naphtha may be used for cleaning badly soaked facings, followed by slight scrubbing with fine grade sandpaper. Friction facings should be replaced when excessive lubricant is found.

CLUTCH DIAGNOSIS

ENGINE CLUTCH SLIPPING.

CAUSES

1. Driver riding clutch pedal.
2. Insufficient or no clutch pedal lash.
3. Clutch release shaft tight in housing.
4. Weak or broken clutch pressure springs.
5. Grease or oil on clutch friction facings.
6. Badly worn or burned friction facings.
7. Friction facings improperly installed on clutch driven plate.
8. The use of incorrect type of friction facings.
9. Clutch toggle levers improperly adjusted.
10. Improper assembly of unit parts of clutch.

ENGINE CLUTCH GRABS OR CHATTERS DURING ENGAGEMENT.

CAUSES

1. Loss of tension in clutch facing cushioning plates.
2. Use of incorrect type of clutch facing.
3. High spots on clutch friction facing.
4. Clutch friction facings coated with gum.
5. Clutch shifter shaft tight in housing.
6. Facings loose on driven plate.
7. Driven plate loose at hub.
8. Excessive lash in power transmitting units.
9. Clutch driven plate tight on transmission pinion shaft splines.
10. Clutch case or pressure plate assembly loose on flywheel.
11. Clutch pressure plate badly cracked or broken.
12. Incorrect assembly of unit parts of clutch.
13. Hill holder not properly adjusted.

ENGINE CLUTCH NOISES.

DESCRIPTION

Engine clutch noises are usually encountered when the engine is idling. It is important that a noisy release bearing be correctly diagnosed, because a release bearing noise is somewhat similar to that produced by a worn transmission pinion bearing.

Insufficient clutch pedal lash, a weak or broken pedal or release bearing collar spring may also cause a noisy clutch operation.

CAUSES

1. Clutch noisy when disengaged (pedal depressed).
   - A. Clutch release bearing worn, dirty, damaged or broken.
   - B. Clutch release bearing binding in release shaft arms.
   - C. Crankshaft clutch pilot bearing worn, damaged, broken or inadequately lubricated.
   - D. Clutch toggle levers improperly adjusted and bottoming against driven plate hub.
2. Clutch noisy when engaged (pedal released).
   - A. Misalignment of transmission with engine assembly causing slight movement of clutch driven plate hub on hub insulator. (Noise noticeable with engine idling or at low road speeds.)
   - B. Clutch driven plate hub loose on transmission pinion splines.
   - C. Clutch driven plate dampener springs weak or broken.

ENGINE CLUTCH SPINNING (DRAGGING) WHEN DISENGAGED.

CAUSES

1. Incorrect clutch pedal adjustment (too much pedal lash).
2. Incorrect release lever adjustment.
3. Warped or distorted clutch center driven plate.
4. Clutch facing cushioning plates distorted.
5. High spots on friction facings.
6. Clutch driven plate facings incorrectly installed or loose.
7. Clutch driven plate hub tight on pinion shaft splines.
8. Rough, distorted or burred pinion shaft splines.

ABNORMAL OR PREMATURE ENGINE CLUTCH FACING WEAR.

CAUSES

1. Insufficient pedal lash.
2. Driver rides clutch pedal.
3. Driver slips clutch excessively during time of engagement.
4. Abnormal and unnecessary use of clutch.
5. Weak or broken clutch pressure plate springs.
6. Badly warped clutch pressure plate.
7. Use of incorrect type of friction facing.
8. Friction facing improperly installed.

ENGINE CLUTCH PEDAL PULSATION.

DESCRIPTION

Clutch pedal pulsation has oftentimes been termed a nervous pedal. When a slight pressure is applied on the pedal, with the engine running, the pedal will vibrate or bounce with every revolution of the engine. As the pressure on the pedal is increased the pulsation will cease.

CAUSES

1. Clutch toggle levers unevenly adjusted.
2. Clutch case sprung by improper installation.
3. Clutch release shaft arms not parallel.
4. Clutch release shaft bent.
5. Clutch pedal pull back spring missing or broken.
6. Severe case of misalignment between transmission and engine assembly.
7. Flywheel not properly seated on crankshaft flange.
8. Bent crankshaft flywheel flange.

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PROPELLER SHAFT AND UNIVERSAL JOINTS

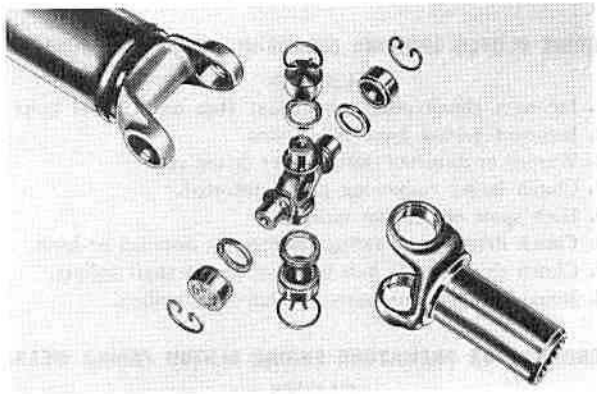
GENERAL

• The universal joints used on all models are of the needle bearing type. These needle bearings are entirely enclosed. The companion flange of the rear axle includes a yoke to which the universal joint cross and needle bearing assembly is attached by means of retaining clips or "U" bolts.

Snap lock rings, located in the yoke at the outer ends of the bearings, are used to retain the universal joint crosses in the front and rear propeller shaft yokes. Each bearing assembly includes a cork lubricant seal and dust cap.

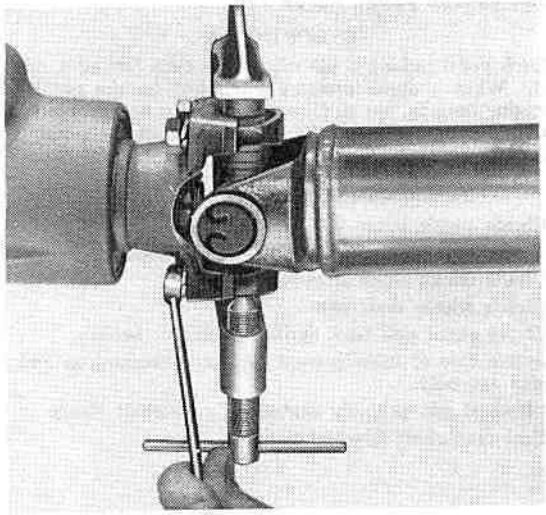
SERVICE TOOLS

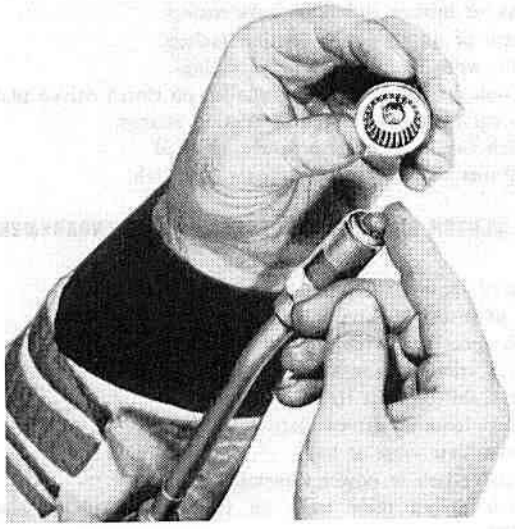
J-881 Universal Joint Assembly Clamp



COUPE EXPRESS Snap lock rings which retain the universal joint cross in the front and rear propeller shaft yokes are located in the yoke at the outer end of the bearings. A cork lubricant seal and dust cap are included for each bearing assembly.

The companion flange includes a yoke to which the universal joint cross and needle bearing assembly is attached by means of retaining clips or "U" bolts.





COUPE EXPRESS Needle bearing assemblies should be lubricated with a chassis lubricant (semi-fluid type) at 5,000 — 10,000 mile (8.046 — 16.090 Km) intervals. Always use new cork washers when repacking the assemblies. Use the grease fitting to lubricate the splined end of the shaft.

COUPE EXPRESS Installation of the bearing assembly in the yoke is facilitated by using the Universal Joint Assembly Clamp J-881.

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PROPELLER SHAFT AND "U" JOINT SPECIFICATIONS

		COUPE EXPRESS	STANDARD			HEAVY DUTY		
Wheelbase		113"	120"	128"	152"	128"	152"	195"
Model			R96	R96	R96	R96	R96	R96
Length — Center to Center of Universals	Single	69-1/2" (1765,3 mm)	72-7/16" (1839,9 mm)	—	—	—	—	—
	Front	—	—	41-3/8" (1050 mm)	41-3/8" (1050 mm)	*37-17/32" (953,3 mm)	*37-17/32" (953,3 mm)	*71-3/4" (1822 mm)
	Rear			39-1/8" (993,7 mm)	63 (1600 mm)	*39-1/8" (993,7 mm)	*63 (1600 mm)	*71-11/16" (1821 mm)
Outside Diameter of Shaft	Single	3-1/2" (88,9 mm)	3-1/2" (88,9 mm)	—	—	—	—	—
	Front	—	—	2" (50,8 mm)	2" (50,8 mm)	2" (50,8 mm)	2" (50,8 mm)	3" (76,2 mm)
	Rear	—	—	2" (50,8 mm)	3" (76,2 mm)	2-1/2" (63,5 mm)	3" (76,2 mm)	3-1/2" (88,9 mm)

SPECIAL SET-UP

		4 SPEED TRANS.				TWO SPEED REAR AXLE		
Length — Center to Center of Universals	Single	67-9/16" (1716 mm)				72-7/16" (1840 mm)	—	—
	Front	—				—	37-17/32" (953,3 mm)	71-3/4" (1822 mm)
	Rear	—				—	59-1/8" (1501,7 mm)	67-7/8" (1724 mm)
Outside Diameter of Shaft	Single	3"				3-1/2" (88,9 mm)	—	—
	Front	—				—	2" (50,8 mm)	3" (76,2 mm)
	Rear	—				—	3" (76,2 mm)	3-1/2" (88,9 mm)
With O. D. and *Free Wheeling*	Single	59-5/8" (1514 mm)	—	—	—	—	—	—
			—	—	—	—	—	—
	Outside Diameter	2-3/4" (69,85 mm)						

* — Heavy Duty with H. D. Rear Axle Also.

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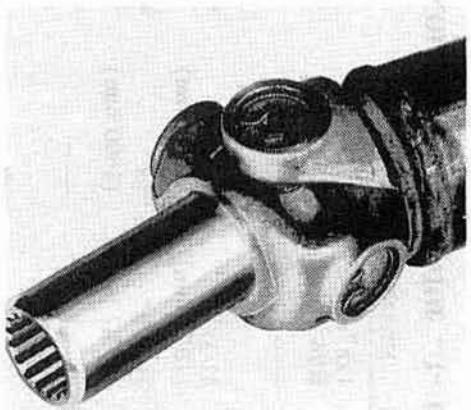
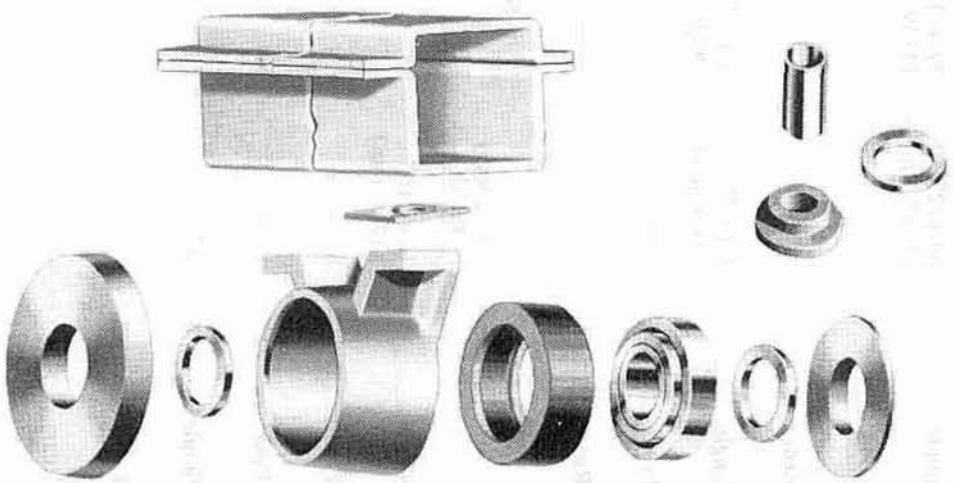
COUPE EXPRESS On models equipped with a conventional transmission, the flange is fastened to the transmission rear shaft. A slip joint in the propeller shaft compensates for the movement of the rear wheels. The universal joints and the propeller shaft are balanced in production; the front yoke and the splined end of the shaft being marked by arrows. If the front joint is removed from the propeller shaft, the arrows must be aligned when reassembling the shaft. The sliding joint on this type of propeller shaft should be lubricated at 1,000 mile (1.609 Km) intervals with a light pressure gun grease. To lubricate it, remove the plug in the sliding joint and insert a grease fitting. Be sure to replace the grease plug after lubrication.



COUPE EXPRESS On models equipped with overdrive, movement of the rear wheels is compensated by a slip joint which slides on splines of the transmission mainshaft. No lubrication is necessary for this sliding joint.



STANDARD AND HEAVY DUTY On the longer wheelbase models which are equipped with two propeller shafts, a midship bearing is used between the two shafts. This bearing is of a prepacked, sealed type, insulated in rubber. The rubber insulator is assembled around the bearing and then forced into the midship bearing hanger. When assembling the rubber insulator, take care not to wrinkle or pinch the rubber. The bearing support housing is insulated from the frame cross-member through rubber grommets. When assembling the bearing support to the frame cross-member, align the bearing by shifting the bearing support housing backward or forward until the housing fastening bolts are in direct alignment. The housing is then assembled to the frame cross-member, using the rubber grommets between the housing and the lower side of the cross-member. Be sure the fastening nuts are bottomed tight against the spacers which control the compression of the grommets.

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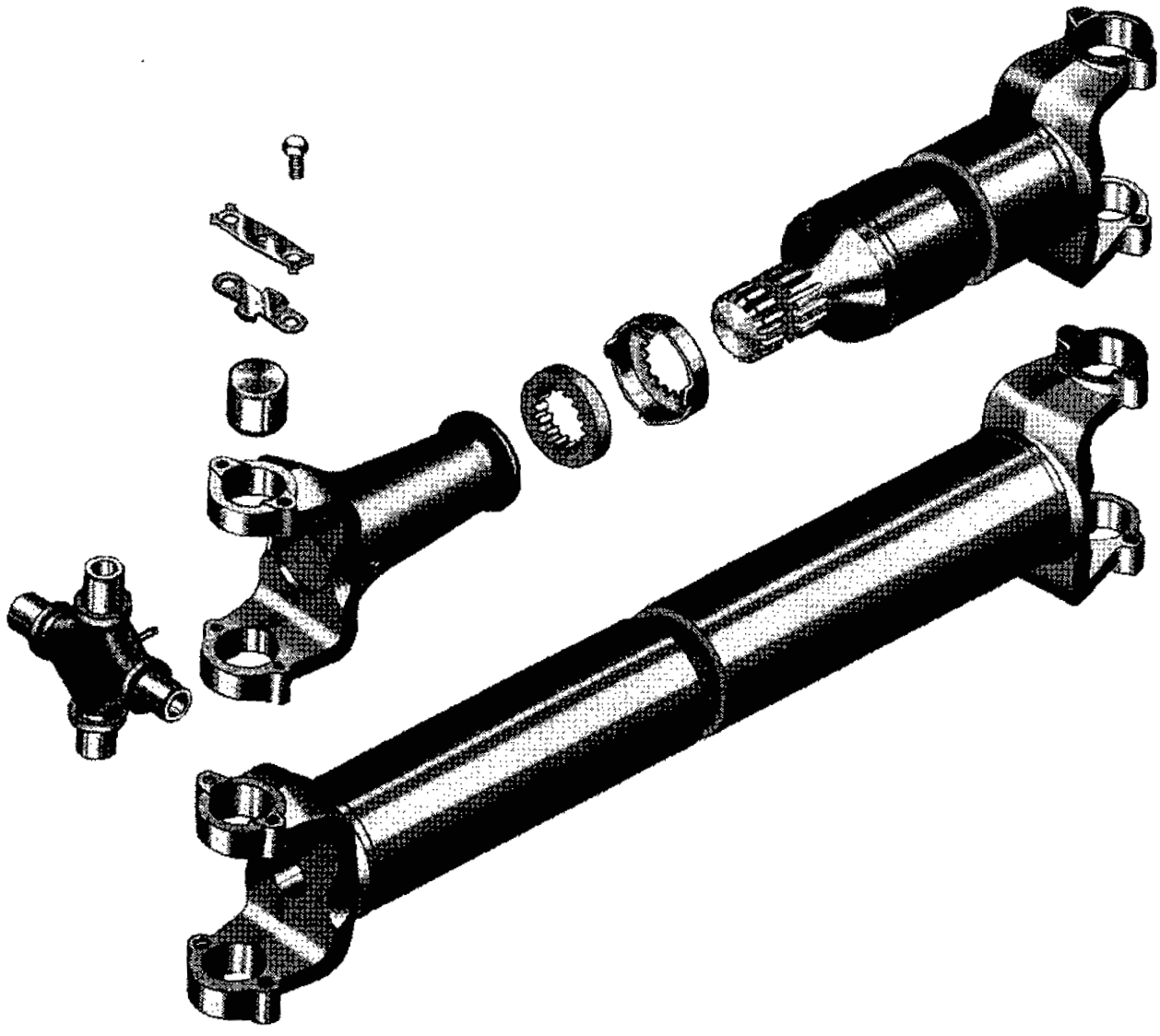

Parts of the Standard and Heavy Duty universal joints.

STANDARD AND HEAVY DUTY Universal joints on these models are of the Cleveland needle bearing type. Cork packing rings are used as a seal to prevent the entrance of dirt into the bearings and to retain the lubricant in the bearings. In the external surface of the universal joint cross is a permanent grease tube fitting. The joints are lubricated with pressure gun grease and protected against extreme pressure by a small escape valve. The joint should be filled until the lubricant is forced out of this valve. Use only a good grade of pressure gun grease of approximately the consistency of vaseline.

The universal joints and the propeller shaft are balanced; the rear yoke and the splined end of the shaft are marked by arrows. When reassembling the shaft, make sure these arrows are aligned with one another.

A grease fitting is attached for lubrication of the propeller shaft splines. Use only a light pressure gun grease.

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REAR AXLE

REAR AXLE SPECIFICATIONS

	Coupe Express M5 St'd.	Standard and Heavy Duty M15 — M16 St'd.	Heavy Duty M16 H. D.	Heavy Duty M16 Two Speed
Make	Spicer 2040	*Timken 53625	†Timken 53521	Timken 93422
Axle Shaft Type	Semi-Floating	Full Floating	Full Floating	Full Floating
Type of Drive	Hypoid	Spiral Bevel	Spiral Bevel	Spiral Bevel
Axle Shaft Diameter	1-7/64" (28,18 mm)	1-9/16" (36,69 mm)	1-9/16" (36,69 mm)	1-9/16" (36,69 mm)
Axle Spline Diameter	1-7/32" (30,96 mm) 10 Splines	1-3/4" (44,45 mm) 16 Splines	1-3/4" (44,45 mm) 16 Splines	1-3/4" (44,45 mm) 16 Splines
Spring Center Distance	39-1/2" (100,33 mm)	39-1/2" (100,33 mm)	39-1/2" (100,33 mm)	39-1/2" (100,33 mm)
Gear Ratio—Standard	4.82	5.66	5.66	5.64/8.22
Gear Ratio—Optional	4.55	M15=5.14 M16=6.6	5.14 6.6	—— ——
Backlash—Pinion and Ring Gear	.005"—.007" (0,127—0,178 mm)	.007"—.010" (0,178—0,254 mm)	.007"—.010" (0,178—0,254 mm)	.007"—.010" (0,178—0,254 mm)
Back-up Screw to Gear Clearance	None	.010"—.015" (0,254—0,38 mm)	.010"—.015" (0,254—0,38 mm)	.010"—.015" (0,254—0,38 mm)
Road Clearance with Standard Tires	7-3/8" (187,33 mm)	M15—7" (177,8 mm) M16—8-1/2" (215,9 mm)	8" (203,8 mm)	8-3/16" (208 mm)
Lubricant Capacity U. S. Pints	3	6-1/8	7	12
Lubricant Capacity Imp. Pints	2.5	5.1	5.83	10
Lubricant Capacity Liters	1,43	2,87	3,31	5,64
Lubricant Winter	Special Hypoid	S. A. E. No. 90 below +32° F. (0° C.)	Same for H. D. and Two Speed	
Lubricant Summer	S. A. E. No. 90	S. A. E. No. 140 above +32° F. (0° C.)		

*—With single or dual wheels for M15 and with single wheels only for M16.
†—To be used with dual wheels.

SERVICING TOOLS—REAR AXLE

ST-500	Wheel Hub Puller Shims — .003", .005", .010" and .030"
HM-931	Rear Axle Shaft Puller
J-270-1	Handle
J-270-6	Disc
J-589-D	Pinion Setting Fixture
HM-925	Utility Puller
636370	Side Bearing Cup Puller Axle — M15-16

COUPE EXPRESS The rear axle assembly is the hypoid, semi-floating type with shim adjustments for all bearings and the ring gear and pinion. The axle shafts are splined at the inner ends to fit into splines in the differential side gears. The outer ends of the shafts are provided with a taper and keyway for attaching the rear wheel hubs. The wheels are each supported on a tapered roller bearing pressed on the axle shaft. Side thrust from the wheels is transferred from one shaft to another by a thrust block straddling the differential pin.

COUPE EXPRESS Use Studebaker hypoid lubricant or any hypoid lubricant (S. A. E. No. 90) manufactured by a reputable oil company. *Do not at any time mix various brands of hypoid lubricants.* If the brand is changed, or if there is doubt about the brand of lubricant in the axle, drain and flush the rear axle housing with a light engine oil before installing new lubricant. Do not use kerosene for flushing. Check the lubricant level every 5,000 (8.046 Km.) miles. Drain and refill to the bottom of the filler plug hole every 10,000 (16.090 Km.) miles.

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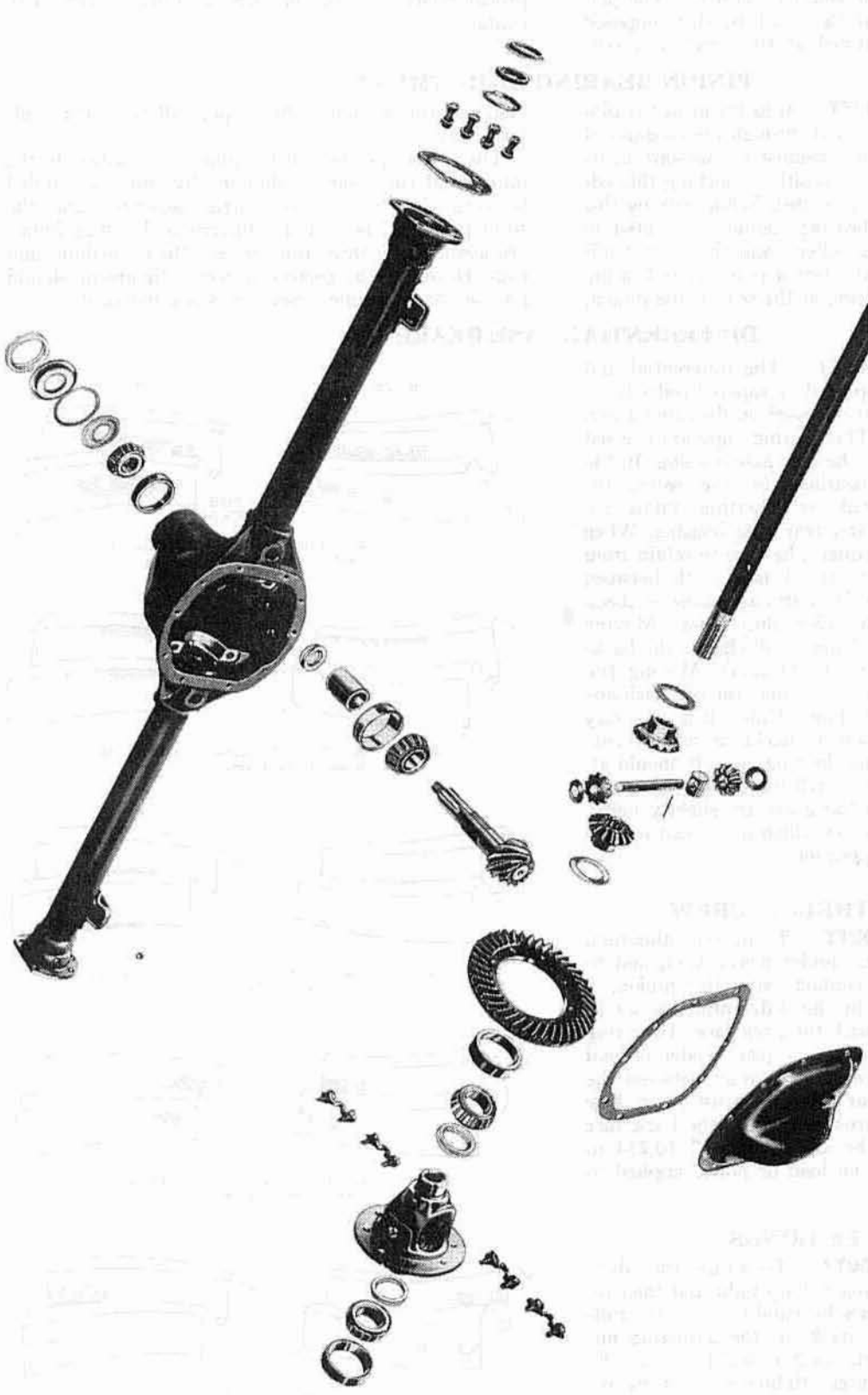

Parts of the Coupe Express Rear Axle.

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STANDARD AND HEAVY DUTY The standard rear axle in the Standard and Heavy Duty models is the full floating type with the spiral bevel drive. The pinion shaft is supported at the front by dual opposed tapered bearings and piloted at the rear by a self-contained straight roller bearing. This straddle-mounting of the pinion holds the pinion gear securely in the proper relation to the ring gear, assuring proper tooth contact.

PINION BEARING ADJUSTMENT

STANDARD AND HEAVY DUTY Adjustment of the pinion forward bearing is secured through the medium of an adjusting nut which acts against the forward bearing cone. A ready means of positively locking this adjusting nut in position is provided. While making this adjustment, the pinion bearing should be rotated in order to seat the bearing rollers, and the correct adjustment will be obtained when a perceptible bearing drag can be felt. The bearing at the rear of the pinion, being of the straight roller type, will require no adjustments.

The correct position of the pinion, in relation to the differential ring gear, is obtained by shims assembled between the drive pinion carrier assembly and the front machined face of the differential housing. Shims are available in three thicknesses; thick, medium and thin. However, the correct factory adjustment should not be changed unless new gears are installed.

DIFFERENTIAL CASE BEARINGS

STANDARD AND HEAVY DUTY The differential and ring gear assembly is supported on tapered roller bearings. The bearing cones are pressed on the ground hub of the differential case. The bearing cups are pressed into machined recesses in the rear axle housing. In the event the differential bearings become worn, the bearings can be adjusted by inserting shims between the bearing cups and rear axle housing. When making the bearing adjustment, be sure to retain from .007" to .010" (0,178 to 0,254 mm) lash between the ring and pinion gears. It is also advisable to check tooth contacts at this time. (See illustration.) Moving the ring gear .005" (0,127 mm) will change the backlash approximately .0035" (0,09 mm). Moving the pinion .005" (0,127 mm) will change the backlash approximately .001" (0,0254 mm). Unless it is necessary to change the tooth contact, backlash adjustments should be made by moving the ring gear. It should always be remembered that a well located tooth contact is more desirable even if the gears are slightly noisy, than a poorer located contact which may seem to produce a temporary quiet operation.

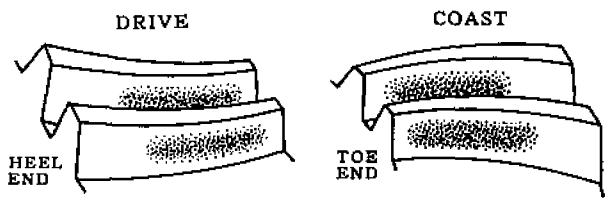

Fig. 1. Ideal Ring Gear Tooth Contact Under Light Load

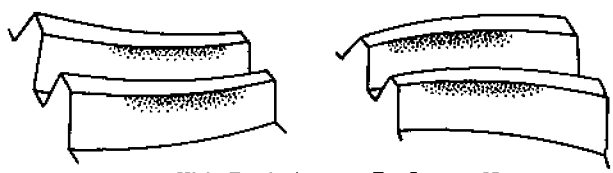

Fig. 2. High Tooth Contact—To Correct Move Pinion Toward Gear

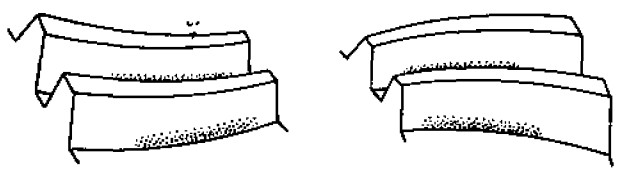

Fig. 3. Low Tooth Contact—To Correct Move Pinion Away From Gear

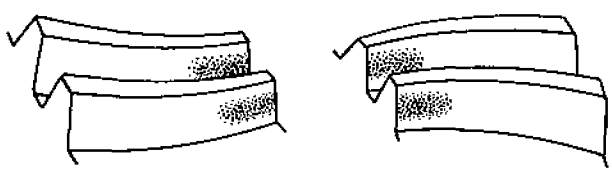

Fig. 4. Toe Contact—To Correct Move Gear Away From Pinion

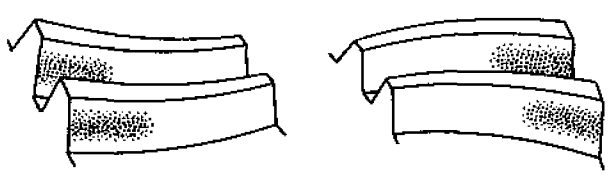

Fig. 5. Heel Contact—To Correct Move Gear Toward Pinion

RING GEAR THRUST SCREW

STANDARD AND HEAVY DUTY To prevent abnormal deflection of the ring gear under heavy load, and to maintain correct tooth contact with the pinion, a thrust plate is installed in the differential carrier so that it comes in contact with the back face of the ring gear directly opposite the pinion gear. Under normal operating conditions there is no contact between the back face of the ring gear and the thrust plate. The clearance between the thrust plate and the back face of the ring gear should be .010" to .015" (0,254 to 0,38 mm) when there is no load or power applied to the gears.

WHEEL BEARINGS

STANDARD AND HEAVY DUTY To adjust the wheel bearings, turn the adjusting nut up tight and then revolve the wheel a few times by hand to allow the rollers to seat in the cups. Back off the adjusting nut 1/4 turn, install the lock washer and lock nut. Be sure the lock nut is securely tightened. Test by rotating the wheel. If a perceptible drag is felt, readjust by loosening the inner wheel bearing nut.

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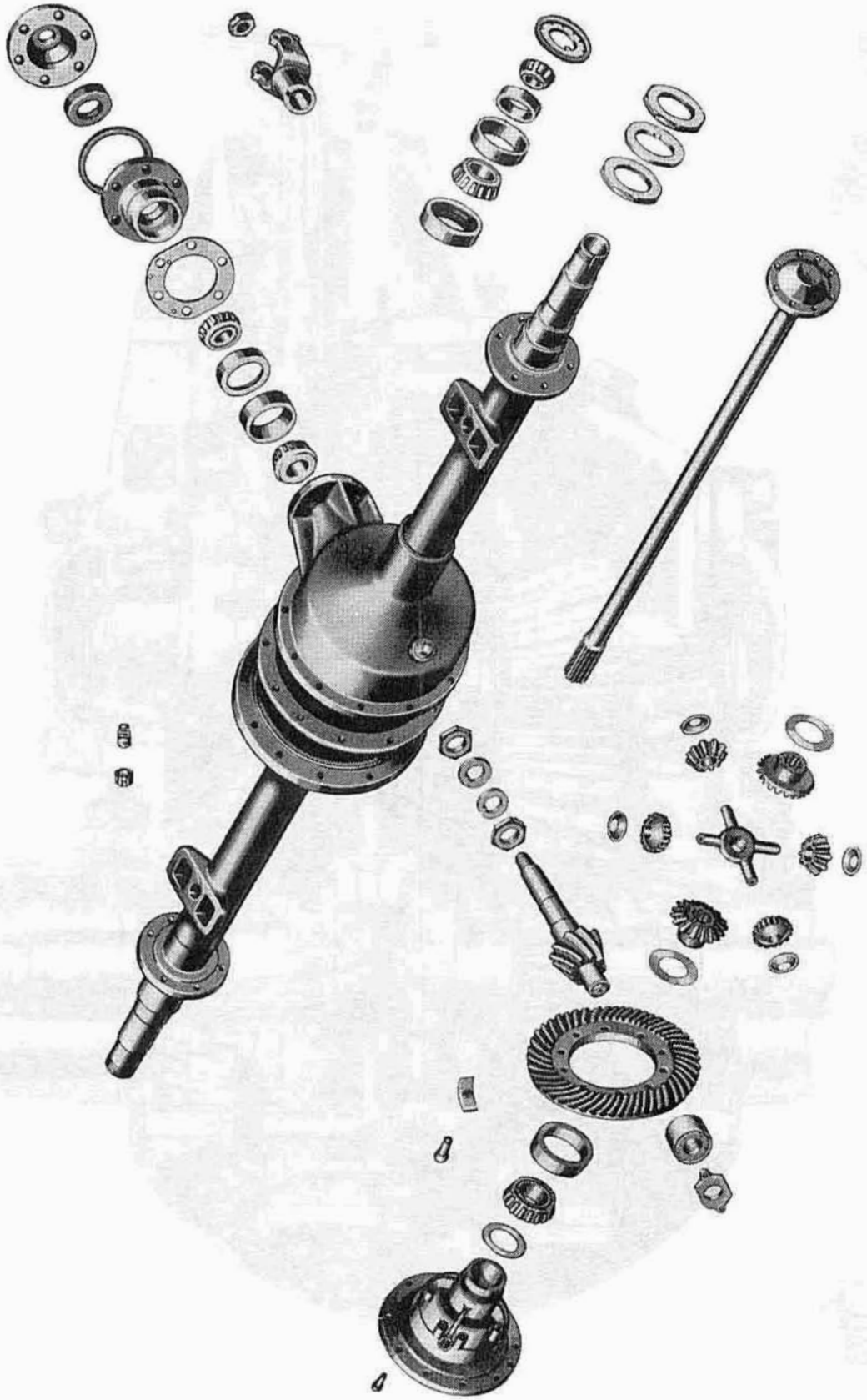

Parts of Standard and Heavy Duty standard rear axle.

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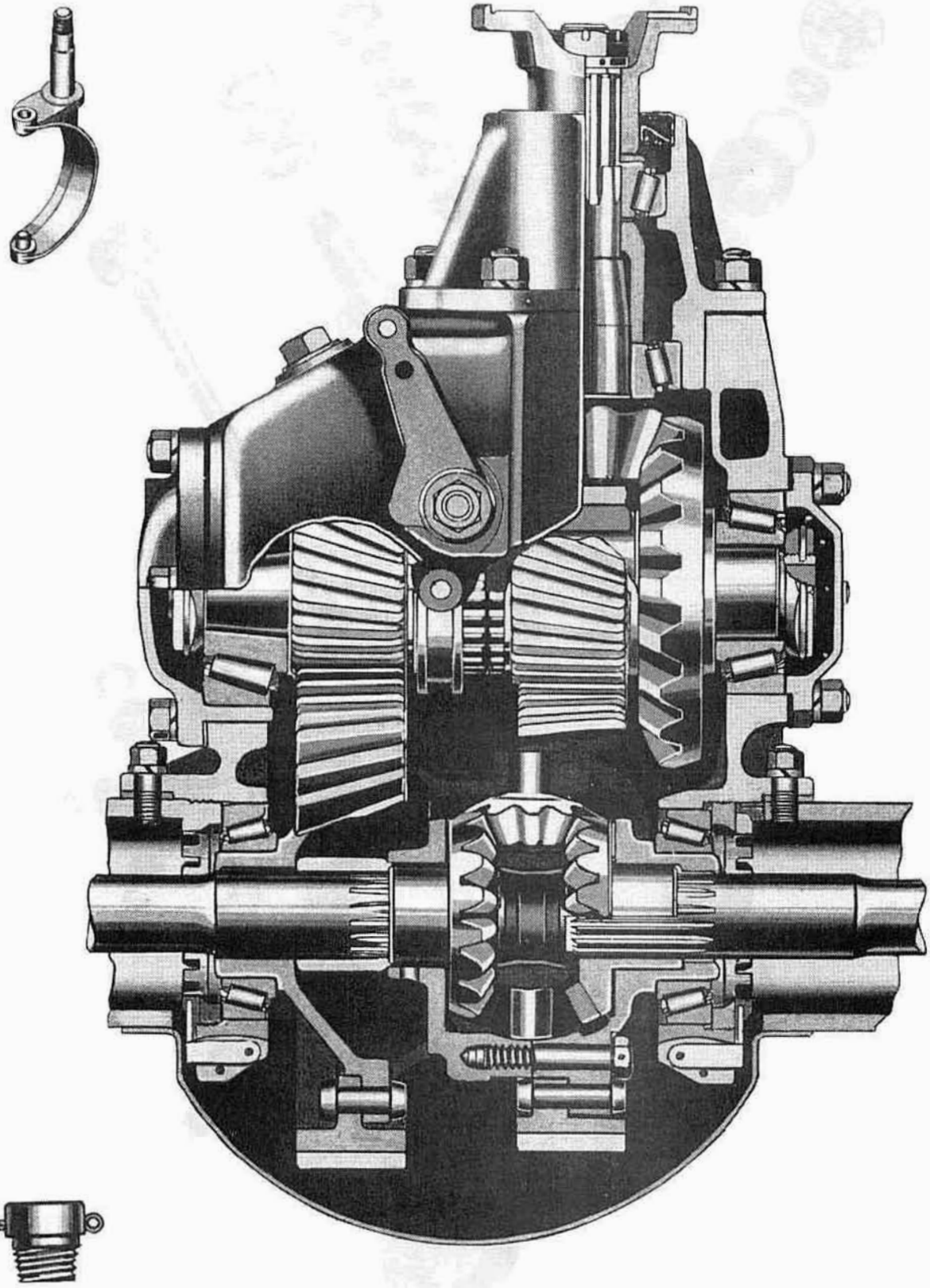

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TWO-SPEED AXLE

HEAVY DUTY The Timken two-speed axle combines two full size final drives of the Wisconsin double reduction type in one housing. The second speed is obtained by an additional helical pinion on the cross shaft, and a second gear on the differential. Both helical pinions float on the cross shaft. Either may be engaged by a clutch collar located between them. When engaged, the pinion rotates with the shaft and drives its mating helical gear on the differential.

Selection of gears, which is controlled from the cab, slides the clutch collar into engagement with external teeth on the helical pinion. The clutch collar itself rotates with the cross shaft and is driven by splines on it.

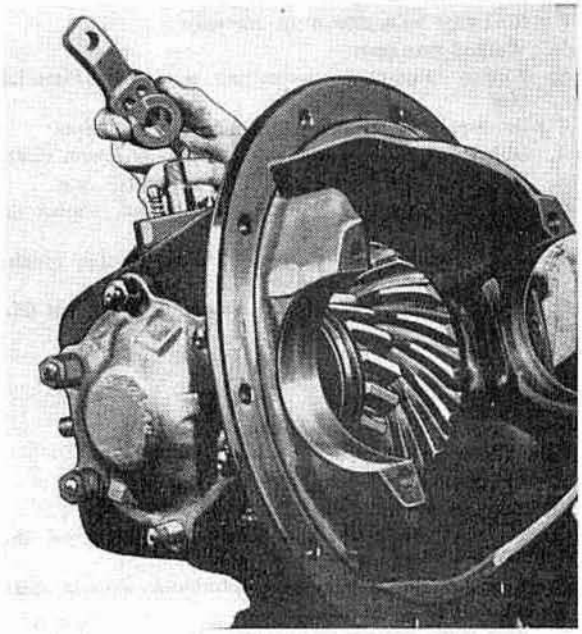
The two sets of helical pinions and gears have different ratios, one higher than the other — thus two driving speeds are obtained.

To remove the carrier assembly, drop the propeller shaft at the forward end of the differential carrier. Remove the axle shafts by removing the stud nuts at the hub. After removing the stud nuts which hold the carrier in the housing, the carrier itself can be pulled out, using a jack to support its weight during the process.

Put the carrier assembly in a bench vise, clamping its lower rib. Mark the differential bearing caps and adjusting nuts so they may be reassembled in their original positions. This is important because these caps are machined in place.

Remove the differential bearing adjusting nut locks and the bearing cap screws. The bearing caps may then be taken off and the differential, with helical gears assembled, may be removed.

The bevel pinion shaft and pinion bearing cage is a separate unit and can be removed from the carrier by removing the nuts which hold it, and inserting puller screws in the tapped holes of the cage flange.



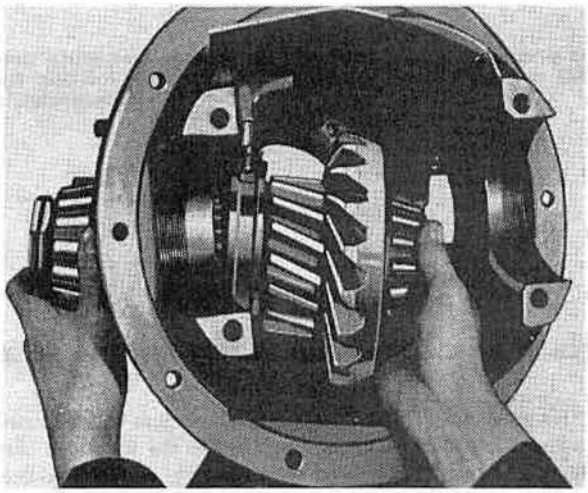
Removing the shifter lever.

When removing the pinion cage and cross shaft bearing caps, remember to check the number and thickness of the shims so that in reassembling these units they will be shimmed as they were originally.

Remove the shifter lever retaining nut with its lock washer. Now remove the shifter lever and be careful not to lose the shifter lever pin and spring which bear against the under side of the shifter lever. This will allow for disassembling the cross shaft.

The cross shaft assembly is mounted on two Timken roller bearings and carries the bevel gear, the two helical pinions and the cross shaft clutch. The bevel gear is mounted on the cross shaft on a tapered spline and is held in place by a bearing cone. This cone is locked by a nut and lock ring. The two helical pinions are a free fit on the shaft.

In removing the cross shaft, first take off the left bearing cap. A short bar can be used between the back of the ring gear and the carrier to aid in removing this cap, which is piloted in the carrier. With this cap removed the entire cross shaft, gear and bearing assembly can be worked out by sliding it to the left side of the carrier and pulling the ring gear toward the rear



Remove the cross shaft gear and bearing assembly by sliding it to the left and pulling the ring gear toward the rear.

— then threading the assembly past the differential bearing supports.

By removing its retaining lock and nut the bevel gear and bearing can be pressed off the shaft. Next remove the shifter clutch and be careful not to lose the three balls and springs. The low speed pinion and remaining cross shaft bearing can then be pressed off the shaft.

The shifter fork and shaft is mounted in a flange bushing which is a slip fit in the carrier. In removing the fork, apply a screw driver underneath the bushing flange in the slot provided for this purpose, then pry the bushing out. This will release the shifter fork, which can be worked out through the rear of the carrier.

To reassemble the carrier, reverse the preceding operations.

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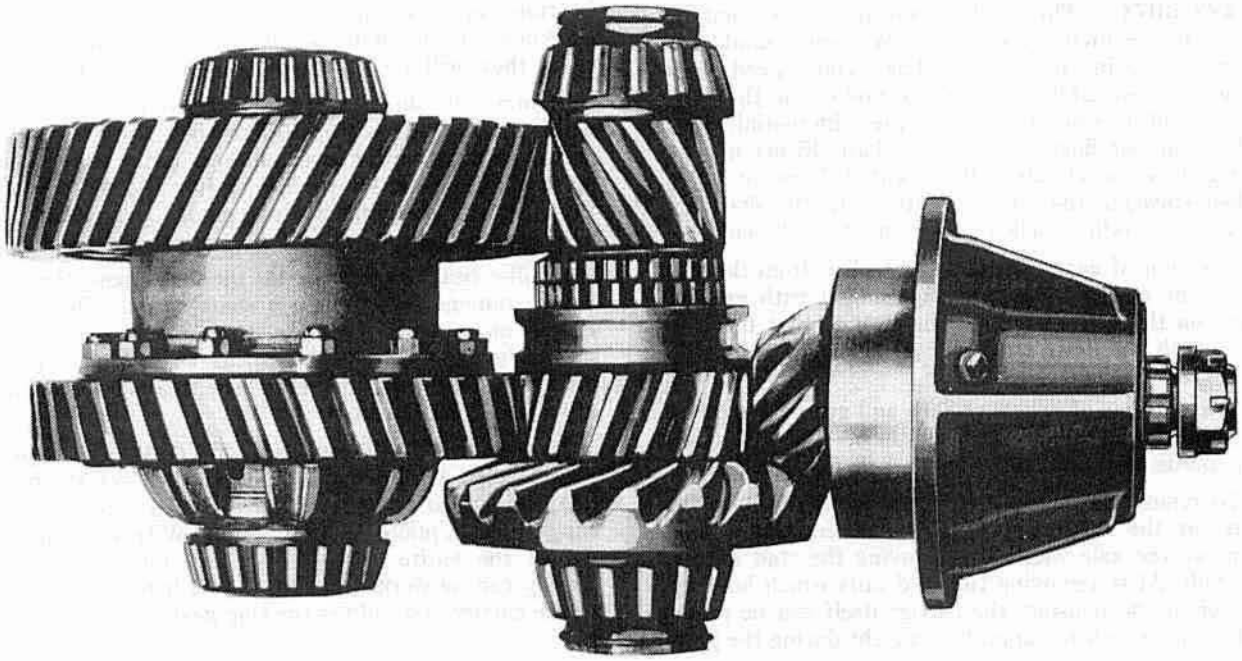

The propeller shaft, through its pinion, transmits power to the bevel gear which actuates the double reduction shaft and high speed pinion, the latter transmitting the power to the double reduction high speed gear through the differential, thence to the axle.

REAR AXLE DIAGNOSIS

REAR AXLE AND DIFFERENTIAL CARRIER ASSEMBLY NOISE.

DESCRIPTION

Rear axle noise is usually apparent as a hum in moderated cases or a growl in severe cases. Usually the tone of a rear axle noise changes, when the car is coasting, or free wheeling, from the noise noticed when the engine is driving the car. Quite often a rear axle will be noisy when the engine is driving the car while no noise will be heard when coasting or free wheeling or vice versa.

Oftentimes difficulties with rear wheel bearings, universal joints, muffler or tire noise are improperly diagnosed as rear axle and differential carrier noise. The possibility of an incorrect diagnosis of these difficulties is great and must not be disregarded when attempting a diagnosis and correction of rear axle noise.

CAUSES

1. Insufficient lubricant in housing.
2. Use of poor quality or incorrect grade of lubricant.
3. Rear wheel bearings scored or rough.
4. Ring gear and pinion not correctly adjusted to provide ideal tooth contact.
5. Ring gear and pinion not matched.
6. Ring gear or pinion teeth badly worn, scuffed, chipped, or improperly cut.
7. Excessive or insufficient ring gear back lash.
8. Loose pinion bearings.
9. Loose differential side bearings.
10. Pitted or broken pinion or differential bearings.
11. Ring gear does not run true (intermittent hum).
    - A. Loose or broken differential bearings.
    - B. Differential case sprung or cracked.
    - C. Ring gear bolts drawn up unevenly.
    - D. Warped ring gear.
    - E. Foreign substance between ring gear and differential case.
12. Carrier assembly noisy on turns only, resulting from:
    - A. Differential pinion gears tight on cross or pinion shaft.
    - B. Differential side gears tight in differential case.
    - C. Differential pinion or side gears chipped, scuffed or otherwise damaged.
    - D. Differential side gears or case thrust bearings rough, scored or otherwise damaged.
    - E. Excessive back lash between differential gears and differential pinions.

RAPID REAR AXLE LUBRICANT LOSS.

CAUSES

1. Loss at rear axle shafts:
    - A. Lubricant level too high in rear axle housing.
    - B. Incorrect grade or poor quality of lubricant.
    - C. Rear axle shaft grease retaining felts improperly installed or badly worn.
    - D. Rear axle shaft felt retainer distorted or loose in bearing retainer.
    - E. Rear wheel bearing retainer loose on end of housing.

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F. Rear wheel bearing gasket damaged or improperly installed.
G. Cracked rear axle housing.

2. Loss at rear axle pinion shaft:
A. Lubricant level too high in rear axle housing.
B. Incorrect grade or poor quality of lubricant used.
C. Pinion oil seal improperly installed or badly worn.
D. Pinion oil seal retainer distorted, loose in housing or improperly installed.
E. Lubricant return passage in carrier housing restricted.
F. Universal joint companion flange hub rough, scored or out of round.
G. Universal joint companion flange loose on pinion shaft.
H. Forward end of pinion carrier tilted downward by use of wedges at spring seats.

PROPELLER SHAFT DOES NOT ROTATE — ENGINE RUNNING AND TRANSMISSION IN GEAR.

CAUSES

1. Engine clutch slippage.
2. Free wheeling clutch slippage.
3. Transmission pinion or mainshaft broken.
4. Transmission gear teeth stripped.
5. Transmission main shaft flange key sheared.
6. Gear shift forks broken.

REAR WHEELS WILL NOT ROTATE — ENGINE RUNNING, TRANSMISSION IN GEAR AND PROPELLER SHAFT ROTATING.

CAUSES

1. Rear axle shaft key sheared.
2. Rear axle shaft broken.
3. Rear axle pinion flange key sheared.
4. Ring gear or pinion teeth stripped.
5. Differential side gear or differential pinion teeth stripped.
6. Differential pin or cross broken.
7. Propeller shaft rear yoke welds broken loose and yoke turning inside propeller shaft tubing.

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S T E E R I N G

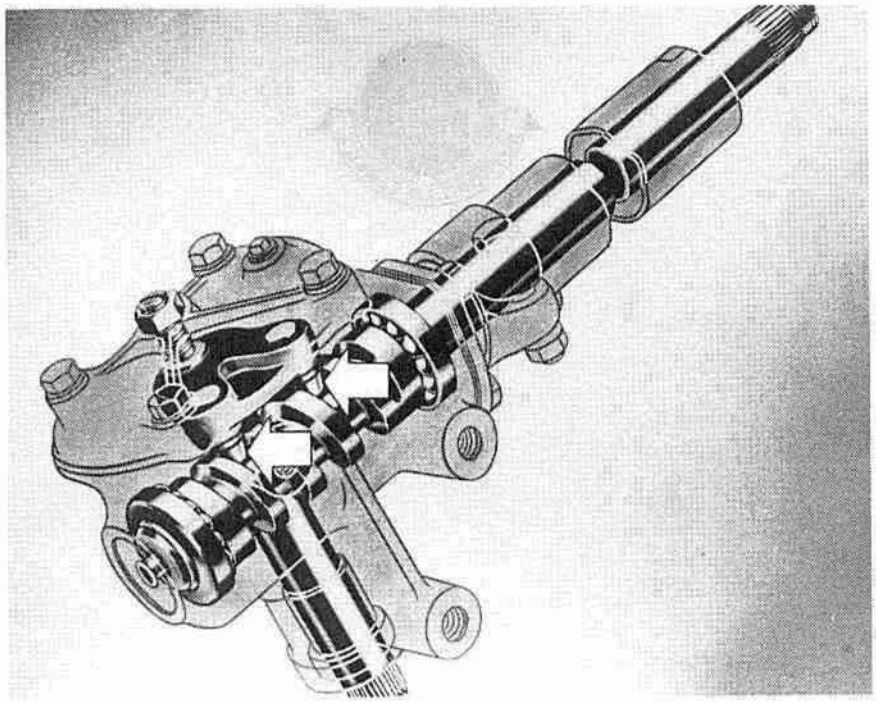
SPECIFICATIONS

	Coupe Express	Standard			Heavy Duty		
Make—Steering Gear	Ross	Ross			Ross		
Type—Steering Gear	Cam and Lever	Cam and Lever			Cam and Lever		
Steering Wheel Size—Std.	17″ (43,18 mm)	17″ (43,18 mm)			17″ (43,18 mm)		
—Opt.	18″ (45,72 mm)	18″ (45,72 mm)			18″ (45,72 mm)		
Steering Gear Model	T-12	T-14			T-14		
Steering Gear Ratio	14.2 to 1	15-17 to 1			15-17 to 1		
Front Axle—Type	Reverse Elliott	Reverse Elliott			Reverse Elliott		
Front Axle—Make	Spicer 41	Timken 29501			Timken 30004		
Camber	1°	1°			1°		
Inclination King Pin	7-1/2°	8°			8°		
Toe-In	1/16″ — 1/8″ (0,0625—0,125 mm)	1/16″ — 1/8″ (0,0625—0,125 mm)			1/16″ — 1/8″ (0,0625—0,125 mm)		
Wheelbase	113″	120″	128″	152″	128″	152″	195″
Caster—Loaded	1°56′	1°12′	1°17′	1°34′	1°7′	1°20′	1°42′
Turning Radius — Left	20′ 3″ (6,2 m)	19′ 8″ (6 m)	20′ 10″ (6,3 m)	25′ 9″ (7,8 m)	22′ 7″ (6,8 m)	26′ 1″ (8 m)	33′ 5″ (10 m)
With Tire Size	6.00x16	6.00x17	6.00x17	6.50x17	6.00x20	32x6	32x6
Turning Radius — Right	20′ 0″ (6,09 m)	19′ 8″ (6 m)	20′ 6″ (6,24 m)	23′ 5″ (7,15 m)	20′ 3″ (6,2 m)	24′ 5″ (7,46 m)	31′ 3″ (9,52 m)
With Tire Size	6.00x16	6.00x17	6.00x17	6.50x17	6.00x20	32x6	32x6

STEERING GEAR

• Steering gears used on all models are the cam and twin lever variable ratio type. The steering gear cam lever shaft is serrated for attachment to the steering drop arm. The gear case is attached to the inside of the left frame side member.

ALL MODELS Phantom view of the steering gear (below).



Construction of the steering gear.

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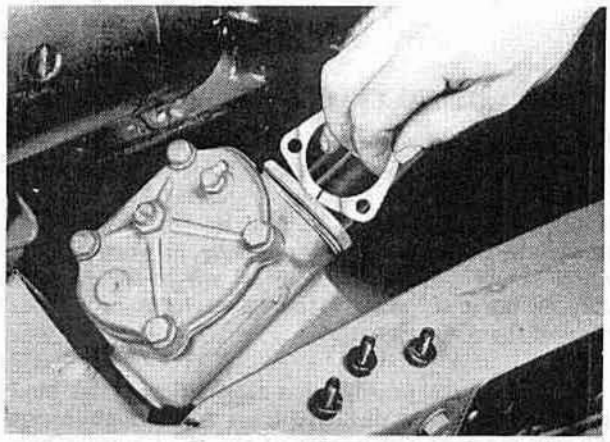
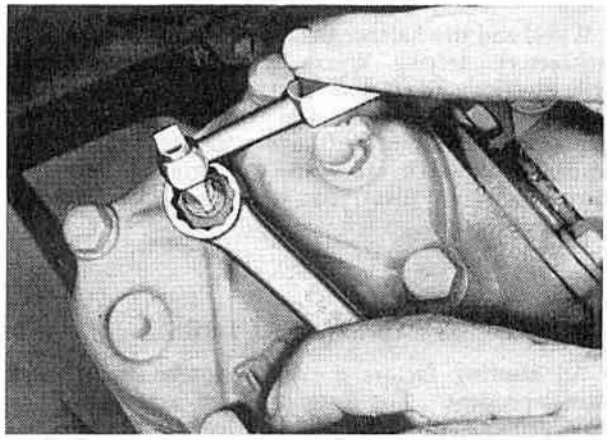
STEERING GEAR ADJUSTMENTS

ALL MODELS The steering post end play should be adjusted first. Back off the cam lever shaft adjusting screw and remove the cap screws which hold the steering post jacket flange to the steering gear case. Then



add or remove the necessary amount of shims to take excessive end play out of the steering post. Do not set it so tight that it drags or undue wear will result. One side of the shims must be slit to remove or add them.

ALL MODELS After the steering post end play adjustment has been made, the steering cross shaft end play can be adjusted by means of an adjusting screw which projects through the gear case cover. This adjusting screw is held in place by means of a lock nut. Loosen the lock nut just enough to turn the adjusting screw and, turning the screw to the right or left, adjust it so that the high spot can just barely be felt as the steering wheel is turned past the center of travel.



ALL MODELS To remove the steering wheel, it is first necessary to take off the horn ring or button by twisting it 1/3 of a turn while the steering wheel is held stationary. After removing the steering wheel retaining nut, the wheel may be pulled from the splines with Puller No. J-1594. If a Utility Puller Set. No. HM-925 is used, it is only necessary to have the adapter, J-1594X.

ALL MODELS When reassembling the steering wheel to the steering post, rotate the steering post through the entire travel and count the number of revolutions. Then rotate the steering post in the opposite direction 1/2 the total amount of travel. The steering wheel should then be replaced in the position shown.

To facilitate the installation of the horn button, apply a thin film of hydraulic brake fluid to the three rubber lugs and reinstall the horn button.

STEERING DIFFICULTIES AND THEIR PROBABLE CAUSES

• The factors of wheel alignment are front axle caster, front wheel camber, steering knuckle pin inclination, front wheel toe-in, front wheel alignment on turns, steering knuckle arm ball position, and chassis spring camber. Other conditions that influence these factors are wheel bearing adjustment, brake adjustment, steering gear and linkage equipment, wheel and tire balance, etc.

FRONT AXLE CASTER — is the amount in degrees that the top of the steering knuckle pin and the axle I-Beam are tilted toward the rear of the vehicle. A condition of this kind is termed "positive caster."

FRONT WHEEL CAMBER — is the amount in degrees that the front wheels are inclined inward at the bottom, and is thus said to be positive camber.

NOTE: An error, commonly encountered among service men, is that of assuming, without careful check and verification, that an error in wheel camber indicates distortion of the front axle I-Beam.

It is evident, of course, that axle distortion will affect the camber of the front wheels but this condition is so rarely encountered, as compared with other causes of camber error, that it should receive consideration only after the other points have been checked and corrected.

To bend an axle as a means of correcting the camber, except in the unusual case where the axle is distorted, merely throws an additional error into the steering layout, instead of correcting the original difficulty.

The proper operation sequence for determining the cause of camber inaccuracies is as follows:

1. Wheel bearing adjustment.
2. Wheel run-out and wobble.
3. Worn king pins and bushings.
4. Bent steering knuckle.
5. Distorted front axle I-Beam.

STEERING KNUCKLE PIN INCLINATION — is the amount in degrees that the top of the knuckle pins are inclined toward the center line of the truck or inward at the top.

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FRONT WHEEL TOE-IN — is the amount (in fractions of an inch) that the front wheels are closer together at the front than they are at the rear — both measurements being taken 9" (228,6 mm) above the floor line with the wheels straight ahead.

FRONT WHEEL ALIGNMENT ON TURNS — (*Steering* Geometry) is the mechanics of keeping the front wheels in proper relative alignment as they are turned to the right or left.

STEERING KNUCKLE ARM BALL POSITION — is the relative position of the arm ball to some reference point on the axle I-Beam (usually the machined surface of the spring pad) when the ball is in the exact straight ahead position over the axle I-Beam.

CHASSIS SPRING CAMBER — denotes the relative position of the top surface of the main leaf (at the center) to a line stretched between the centers of the spring eyes when the car weight is being supported by the springs.

When the top of the center section of the main leaf is below the line stretched between the spring eye centers, the spring is said to have "positive camber." On the other hand, if the center section of the main leaf is above the line the spring is said to have "reverse camber." If the main leaf center is in alignment with (neither above or below) the line drawn between the spring eyes, the camber of the spring would be termed as "zero camber."

CASTER AND ITS EFFECT ON STEERING — Excessive positive caster almost invariably results in a condition of low speed shimmy. A car with "zero caster", that is with king pins vertical, would lack steering stability and would tend to wander over the road.

"Negative caster" will usually result in a vehicle that is difficult to steer, that tends to "dart" to the right or left, and that will turn a corner easily but is hard to straighten out at the end of the curve.

Unequal caster is usually revealed by a tendency of the vehicle to consistently pull to the right or left. This condition is brought about through the axle having been twisted so that there is a greater amount of caster in one king pin than the other. The direction in which the car will tend to pull is away from the pin with the most caster.

The only satisfactory and safe method of correcting this condition is to remove the axle and straighten it cold in a press so that both king pins have the same caster angle. In the event greater or less caster on both sides is desired it can be readily secured through the use of degree shims placed between the bottom of the chassis springs and the top of the axle spring pad. Placing the heavy section of the shim toward the front of the car decreases the positive caster; placing it toward the rear increases the positive caster.

The axle caster specifications listed in the Front End Alignment Chart are to be used when car is not loaded. The limits specified insure satisfactory steering. In making a caster check, both front and rear axles must be level and on the same plane. Caster should be changed by using shims between the axle pads and springs.

CORRECTING FRONT WHEEL CAMBER

• A condition of zero or reverse camber is usually the result of worn or loose steering knuckle pins and bushings, a bent steering knuckle, a steering knuckle that is worn on the underneath side by the outer wheel bearing becoming loose on the spindle, or worn or loose wheel bearings. The correction for any of these conditions is obvious; namely the replacement or adjustment of the required parts.

It is, of course, possible that a condition of this kind may be caused by a distorted front axle brought about through the repeated impact of the front springs bottoming when the vehicle is excessively overloaded or operated over unusually rough roads at relatively high speed. Such a condition will always be evidenced by a variance from the specified king pin inclination. Where this condition is encountered, the axle will have to be straightened cold; DO NOT HEAT THE AXLES IN STRAIGHTENING THEM.

It is preferable that the camber be checked with the weight of the vehicle on the tires as there is some deflection and consequent change in camber due to the weight of the vehicle.

WHEEL BALANCE

Wheel and tire balance play a very important part in satisfactory steering. Where difficulty is encountered with steering, all factors pertaining to the steering mechanism should be checked with accredited equipment. When the front end factors, all of which are dependent upon each other, are synchronized into one correct point of pivot, the steering mechanism will function normally.

STEERING FACTORS

• All steering factors are very closely related and inter-dependent. For instance, front axle caster has very pronounced effect on relative toe-in and the amount of toe-out when the wheels are turned to the right or left. By reason of this inter-dependency any specific steering difficulty may be occasioned by a number of different causes. In the event steering difficulty is encountered it will usually be found that not one, but several factors, are not in accordance with the specifications and, of course, all must be corrected before normal and satisfactory steering can be obtained.

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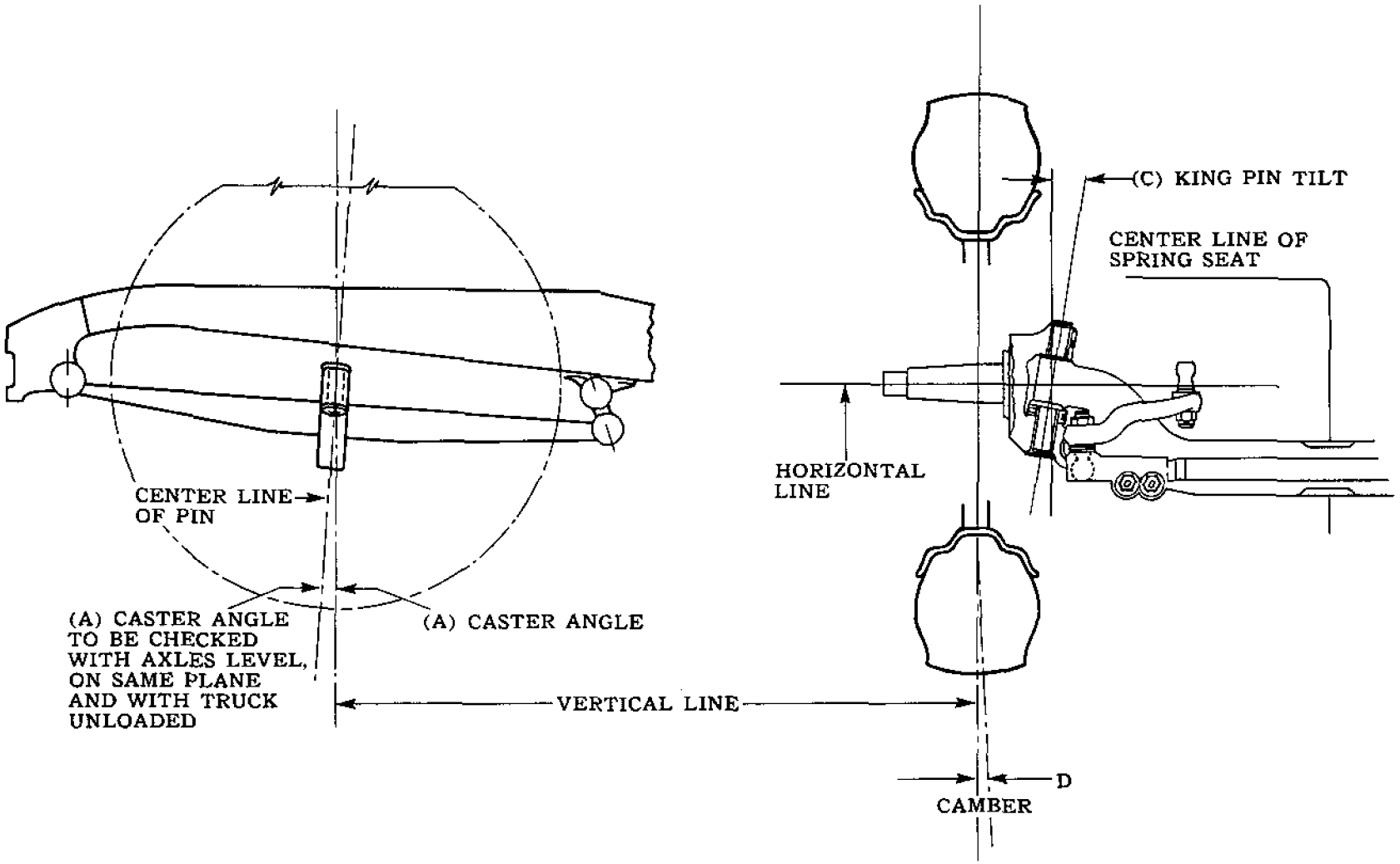
(C) KING PIN TILT
CENTER LINE OF SPRING SEAT
HORIZONTAL LINE
CENTER LINE OF PIN
(A) CASTER ANGLE TO BE CHECKED WITH AXLES LEVEL, ON SAME PLANE AND WITH TRUCK UNLOADED
(A) CASTER ANGLE
VERTICAL LINE
D
CAMBER

Front end alignment chart.

	COUPE EXPRESS	STANDARD			HEAVY DUTY		
"C" King Pin Inclination	7-1/2°	8°			8°		
"D" Camber	1°	1°			1°		
Wheelbase	113″	120″	128″	152″	128″	152″	195″
"A" Axle Caster (Loaded)	1° 56′	1° 12′	1° 17′	1° 34′	1° 7′	1° 20′	1° 42′

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STEERING DIAGNOSIS

ABNORMAL FREENESS IN STEERING SYSTEM.

DESCRIPTION

To provide ease of steering a small amount of backlash of the steering wheel is necessary and the entire steering system must not be adjusted so as to cause a binding action in any part. A free movement of the rim of the steering wheel in excess of 2″ without moving the front wheels is generally considered excessive and is objectionable to many drivers.

CAUSES

1. Excessive looseness in steering gear assembly due to:
   - A. Improper adjustment.
   - B. Camshaft lever bushings oversize or badly worn.
   - C. Cam lever follower worn, chipped or brinnelled.
   - D. Steering gear cam worn, chipped, brinnelled, distorted or adjusted off center.
   - E. Steering gear cam bearings worn, broken or incorrectly adjusted.
   - F. Steering wheel loose on post.
2. Steering tie rod and drag link connections loose:
   - A. Worn parts.
   - B. Broken ball seat springs.
   - C. Cross tube ends loose on cross tube.
3. Loose front wheel bearings.
4. Loose or worn steering knuckle bushings or pins.
5. Steering knuckle arms loose at steering knuckles.
6. Steering knuckle arm balls loose in arms.
7. Steering drop arm loose on cam lever shaft.
8. Unusual causes:
   - A. Steering gear case loose on chassis frame.
   - B. Steering post clamp loose on cowl bracket.
   - C. Excessive clearance of steering post in upper jacket bushing.

CAR STEERS HARD.

CAUSES

1. Tires under inflated or unequal inflation.
2. *Tires oversize or abnormally worn.*
3. Abnormal friction in steering tie rod or drag link joints due to:
   - A. Lack of lubrication or improper type of lubricant.
   - B. Dirt accumulation.
   - C. Ball seat or arm ball scored, rough or galded.
   - D. *Arm ball worn out of round (tight on turns).*
4. Abnormal friction in steering gear assembly, due to:
   - A. Lack of lubrication or improper type of lubricant.
   - B. Steering cam shaft follower meshed too deeply with steering gear cam (not sufficient end play of cross shaft).
   - C. *Steering gear cam bearings adjusted too tightly.*
   - D. Steering gear cam lever shaft bearings rough, scored, or otherwise damaged.
   - E. Insufficient clearance of cam lever shaft in bushings.
   - F. Cam lever shaft bushings not in proper alignment.
   - G. Steering gear cam thrust bearings broken, galded, rough or chipped.
   - H. Insufficient clearance of steering post upper bushing on post.
   - I. Steering gear cam or tube sprung or distorted.
   - J. Misalignment of steering gear assembly due to method of mounting at chassis frame and cowl bracket.
5. Excessive friction of steering knuckles, resulting from:
   - A. Lack of lubrication of steering knuckles and knuckle thrust bearings.
   - B. Galded, rough or scored knuckle pins.
   - C. Insufficient clearance between steering knuckle bushings and knuckle pins.
   - D. Insufficient end play of steering knuckle.
   - E. Thrust bearing races galded, brinnelled, rough, scored or full of dirt.
6. Unusual causes.
   - A. Insufficient knuckle pin inclination.
   - B. Improper front wheel camber (reverse or excessive).
   - C. Incorrect front wheel toe-in.

LOW SPEED SHIMMY OR FRONT WHEEL WOBBLE.

DESCRIPTION

High and low speed shimmy are many times confused by the service man. Although many of the causes of high and low speed shimmy are identical, the two conditions have absolutely different characteristics.

Many times a vibration or movement in the steering wheel only is termed shimmy, however, this is an incorrect term and should be avoided. Front wheel shimmy often causes steering movement but originates at the front wheels and is transferred to the steering wheel.

Low speed shimmy or front wheel wobble as the name implies can be simply described as a rapid series of oscillations of the wheel and tire assembly about the knuckle pin. In other words the front wheels attempt to alternately point to the right and left.

High speed shimmy or front wheel tramp can be simply described as a gallop. In other words the condition encountered is very similar to a condition which would be evident if the front wheels were decidedly "egg shaped." In case of severe high speed shimmy, the front tires actually leave the pavement, while in mild cases the condition is the same as if the front *tires were very rapidly deflated and then inflated. In high* speed shimmy one front tire appears deflated while the other is inflated. This condition alternates between the front wheels.

CAUSES

1. Tires under inflated or unequally inflated.
2. Excessive freedom or looseness of steering knuckle thrust bearings.
3. Incorrectly adjusted front wheel toe-in:
   - A. Incorrect adjustment of steering cross tube.
   - B. Bent or sprung steering cross tube.
   - C. Steering cross tube end loose on threads.
   - D. Steering cross tube end parts worn or loose.
4. Worn or loose steering gear parts.
5. Worn or loose steering linkage parts.
6. Loose front spring "U" bolts.
7. Front springs too flexible, resulting from:
   - A. Weak chassis springs.
   - B. Springs overlubricated.
   - C. Inadequate shock absorber control, due to:
     1. Insufficient or incorrect type of fluid in instrument.
     2. Improper adjustment.
     3. Abnormal internal clearances.
8. Incorrect front wheel camber, resulting from:
   - A. Front wheel bearings adjusted too loose.
   - B. Recess cut on underneath side of steering knuckle spindle by rotation of outer bearing cone.
   - C. Steering knuckle bushings or pins worn or loose.
   - D. Bent steering knuckle yoke or spindle.
   - E. Improper adjustment.
9. Unequal front wheel camber (variation of more than 1/2 degree).
10. Irregularities in front wheel tire tread.

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HIGH SPEED SHIMMY OR WHEEL TRAMP.

DESCRIPTION

Both high and low speed shimmy is discussed in Section X —Item 3. It is suggested that this description be reviewed before any corrective measures covering high speed shimmy are attempted.

CAUSES

1. Items affecting low speed shimmy or wheel wobble.
2. Front wheel, hub, brake drum and tire assembly out of balance.
3. Front tires and wheels wobble or do not run true (maximum permissible 1/8").
4. Front wheel tire tread eccentricity or run-out (maximum permissible 1/16").
5. Rear wheel and tire assemblies out of balance.
6. Rear wheel wobble or run-out.
7. Unusual cause:
   A. Dragging front wheel brakes.

STEERING WANDER OR ROAD WEAVE.

CAUSES

1. Tires under inflated or unequally inflated (front and rear).
2. Incorrect or unequal front wheel camber.
3. Worn or loose king pins and bushings.
4. Excessively tight king pins and bushings.
5. Improperly adjusted steering gear or linkage.
6. Front wheels toed-in.
7. Rear axle shifted on rear springs.
8. Cross wind.
9. Type of road surface.
10. Tight tie rod ends.

STEERING KICK BACK.

DESCRIPTION

Steering kick back is registered on the steering wheel as a very rapid movement of the steering wheel and is the result of the front wheels having encountered a bump or obstruction in the road surface and the subsequent transfer of this shock to the steering wheel. A small amount of steering wheel movement must be expected and is normal when the car is driven over an excessively rough road or when the front wheels strike an unusual obstruction.

CAUSES

1. Tires improperly inflated.
2. Chassis springs sagged.
3. Insufficient shock absorber control.
4. Worn, loose or improperly adjusted steering gear parts.
5. Worn, loose or improperly adjusted steering linkage parts.

STEERING GEAR RATTLES.

CAUSES

1. Insufficient lubricant in steering gear assembly.
2. Incorrect grade of lubricant used in steering gear assembly.
3. Excessive lash between cam lever follower and cam.
4. Steering gear cam bearings broken, damaged or incorrectly adjusted.
5. Excessive radial clearance of cam lever shaft in case bushings.
6. Abnormal clearance at steering connections.
7. Steering post jacket clamp loose on jacket or cowl.
8. Steering post jacket loose at lower end.
9. Steering gear loose on chassis frame.
10. Steering drop arm loose on cam lever shaft.
11. Excessive looseness in steering linkage.

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SPRINGS AND

SPRING SPECIFICATIONS

FRONT SPRINGS

MODEL	STANDARD OR HEAVY DUTY	LENGTH	WIDTH	NO. OF LEAVES	DEFLECTION RATE — LBS. PER INCH	THICKNESS AT CENTER
Coupe Express (M5)	Std.	36″ (0,9 m)	1-3/4″ (44,5 mm)	8	265	
	H. D.	36″ (0,9 m)	1-3/4″ (44,5 mm)	9	310	
Standard (M15) 120″ and 128″	Std.	36″ (0,9 m)	2″ (50,8 mm)	7	420	1.733″ (44 mm)
	H. D.	36″ (0,9 m)	2″ (50,8 mm)	9	500	2.209″ (56,1 mm)
Standard (M15) 152″	Std.	36″ (0,9 m)	2″ (50,8 mm)	9	500	2.209″ (56,1 mm)
	H. D.	36″ (0,9 m)	2″ (50,8 mm)	10	560	2.447″ (62,15 mm)
Heavy Duty (M16) 128″ and 152″	Std.	36″ (0,9 m)	2″ (50,8 mm)	10	560	2.447″ (62,15 mm)
	H. D.	36″ (0,9 m)	2″ (50,8 mm)	11	625	2.706″ (68,7 mm)
Heavy Duty (M16) 195″	Std.	36″ (0,9 m)	2″ (50,8 mm)	11	625	2.706″ (68,7 mm)
	H. D.	36″ (0,9 m)	2″ (50,8 mm)	12	700	2.965″ (75,3 mm)

All springs are mounted above the axle. Rubber bushed shackles are used on all springs with single wrapped eyes.

REAR SPRINGS

MODEL	STANDARD OR HEAVY DUTY	LENGTH	WIDTH	NO. OF LEAVES	RATE —	THICKNESS AT CENTER
Rear Springs — No Auxiliary						
M5	Std.					
M15 (120″)*	Std.	45″ (1,14 m)	2-1/2″ (63,5 mm)	8	550	2.391″ (60,7 mm)
M15 All	Std.	45″ (1,14 m)	2-1/2″ (63,5 mm)	8	650	2.625″ (66,7 mm)
	H. D.	45″ (1,14 m)	2-1/2″ (63,5 mm)	11	960	3.625″ (92 mm)
M16 All	Std.	45″ (1,14 m)	2-1/2″ (63,5 mm)	11	960	3.625″ (92 mm)
	H. D.	45″ (1,14 m)	2-1/2″ (63,5 mm)	13	1235	4.312″ (109,5 mm)
Auxiliary Springs						
M5	Opt.					
M15 (120″)*	Opt.	33″ (0,83 m)	2-1/2″ (63,5 mm)	7	600	1.666″ (42,3 mm)
M15 All	Opt.	33″ (0,83 m)	2-1/2″ (63,5 mm)	10	1000	2.506″ (63,6 mm)
	H. D.	33″ (0,83 m)	2-1/2″ (63,5 mm)	11	1300	2.850″ (72,4 mm)
M16 All	Opt.	33″ (0,83 m)	2-1/2″ (63,5 mm)	11	1300	2.850″ (72,4 mm)
Rear Springs — Complete — With Auxiliary						
M5						
M15 (120″)*	Opt.	45″ (1,14 m)	2-1/2″ (63,5 mm)	15	1150	4.057″ (103 mm)
M15 All	Opt.	45″ (1,14 m)	2-1/2″ (63,5 mm)	18	1650	5.131″ (130,3 mm)
	H. D.	45″ (1,14 m)	2-1/2″ (63,5 mm)	22	2260	6.475″ (164,5 mm)
M16 All	Opt.	45″ (1,14 m)	2-1/2″ (63,5 mm)	22	2260	6.475″ (164,5 mm)
	H. D.	45″ (1,14 m)	2-1/2″ (63,5 mm)	24	2535	7.162″ (181,9 mm)

All springs are mounted above the axle.

*—With Pick-Up Box.

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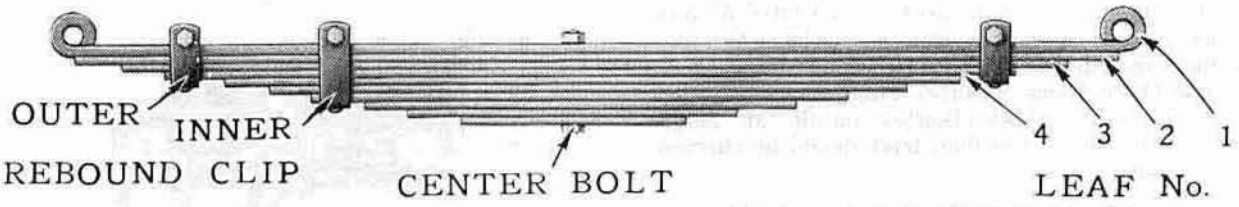
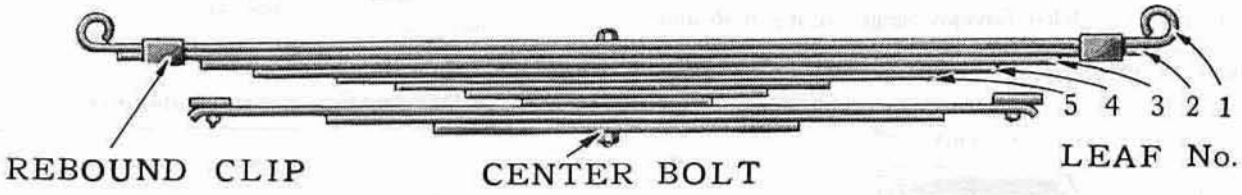
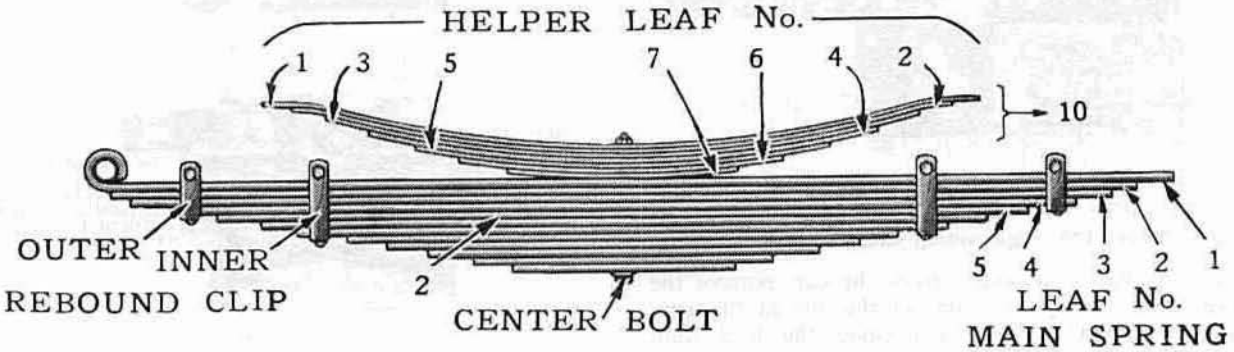
SHOCK ABSORBERS



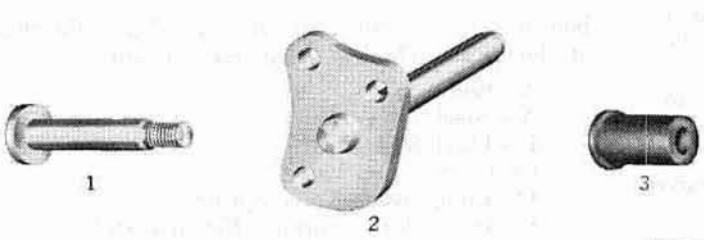
Front spring — All Models.



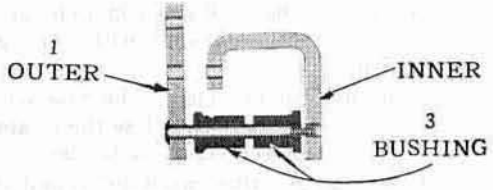
Rear spring with auxiliary — Coupe Express.



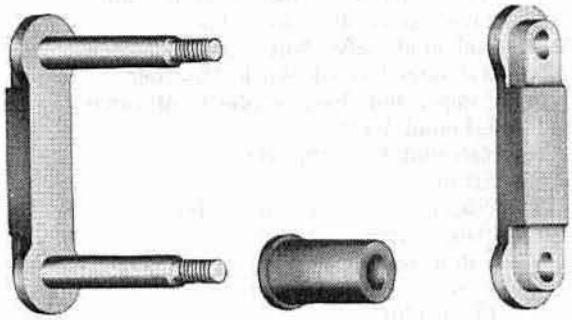
Rear spring with auxiliary — Standard and Heavy Duty.



1—Rear spring bolt (Coupe Express). 2—Rear spring plate with pin (Standard and Heavy Duty). 3—Rear spring bolt and pin rubber bushing (All Models).



Front spring hanger — All Models.



Front spring rear shackle — All Models.

Rear spring rear shackle — Coupe Express.

• The specifications on the opposite page give a comprehensive idea of the spring equipment available for the "M" Series Commercial Cars. The spring combinations shown, in addition to extra leaf equipment available for use in unusual circumstances, should provide adequate spring performance for any type of use. It should be remembered, however, that if the car is equipped for carrying heavy loads, it is bound to ride hard when unloaded.

The front springs on all models and the rear springs on the Coupe Express are mounted in rubber shackles which do not require any lubrication. The rear springs on standard and heavy duty models are mounted in rubber at the front of the springs while a sliding mount is used at the rear. No lubrication is required at the front mounting of the rear springs.

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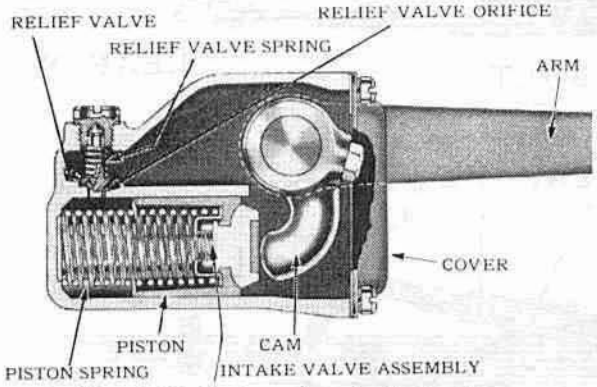
SHOCK ABSORBERS (All Models)

• Delco Lovejoy Shock Absorbers used on the "M" Series commercial cars are finely made and accurately adjusted. They can only be adjusted by changing the sizes of the valves. Outside of filling the shock absorbers at 10,000 mile intervals, it is recommended that adjustments and repairs be made by a United Motors Service Station. These service stations have the special tools and equipment necessary for these operations. Genuine Delco Shock Absorber Fluid is recommended for use in refilling shock absorbers on all "M" Series commercial models. The fluid level should be checked every 10,000 miles.

SHOCK ABSORBERS ON COUPE EXPRESS MODELS

• Type 1430 Delco Lovejoy single acting hydraulic shock absorbers are standard equipment, front and rear, on Coupe Express cars.



Type 1430 single acting shock absorber.

To remove the absorber from the car, remove the wheels if necessary. Disconnect the link at the arm, remove the mounting bolts and remove the shock from the car.

To refill the shock absorber

(a) Mount the shock absorber in a vise at an angle of 45° from horizontal with the valve end "A" up.

Caution: Do not clamp the vise on the absorber body. Use the retaining bolt for the clamping surface.

(b) Clean the absorber carefully around the valve nut before removing the nut.

(c) Remove the valve nut with a screwdriver.

(d) Remove the relief valve with a small hooked tool or a bent wire.

(e) Fill the shock to capacity with new Delco Shock Absorber Fluid.

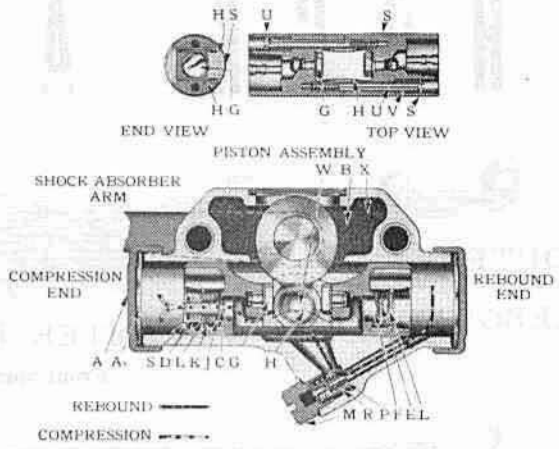
(f) Withdraw a quantity of fluid equivalent to about two (2) tablespoonfuls.

(g) Replace valve and valve nut.

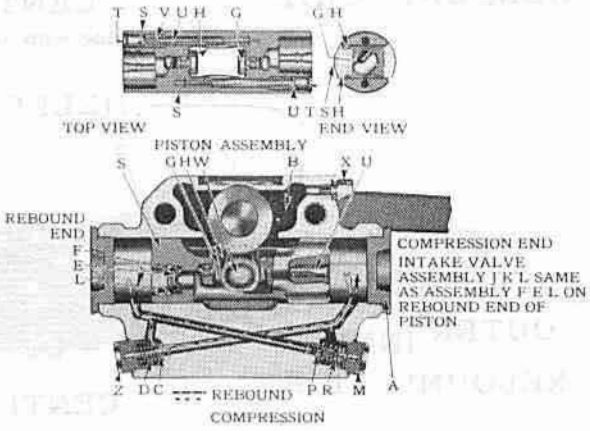
SHOCK ABSORBERS ON STANDARD AND HEAVY DUTY MODELS

• Shock absorbers are optional equipment on Standard and Heavy Duty commercial cars. Two types of absorbers are used on these models, Type 1733 for use on the front and Type 2009 for use on the rear.

Except for the steel spacer (A-1), (there is none used on the 2009 type shock absorber) the letter symbols designating parts on the two shock absorbers are identical. The key to the parts follows:



Type 1733 double acting shock absorber.


T S V U H G
G H
S
U T S H
TOP VIEW
END VIEW
PISTON ASSEMBLY
S G H W B X U
REBOUND END
F E L
COMPRESSION END
INTAKE VALVE ASSEMBLY J K L SAME AS ASSEMBLY F E L ON REBOUND END OF PISTON
Z D C REBOUND P R M A
COMPRESSION

Type 2009 double acting shock absorber.

A—End Cap
A1—Steel Spacer
B—Fluid Reservoir
C—Compression Valve
D—Compression Valve Spring
E—Intake Valve Spring—Rebound end
F—Intake Valve—Rebound end
G—Cam Button
H—Anti-rotation Spring
J—Intake Valve—Compression end
K—Intake Valve Spring—Compression end
L—Valve Spring Retainer Clip
M—Rebound Valve Nut
N—Rebound End of Shock Absorber
O—Compression End of Shock Absorber
P—Rebound Valve
R—Rebound Valve Spring
S—Piston
T—Piston Screw Expansion Plug
U—Piston Screw
V—Piston Screw Spring
W—Cam
X—Filler Plug

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SERVICE OPERATIONS

• To refill the shock absorber on the car, disconnect the link at the lower end, wipe off all dirt around the filler plug, remove the filler plug and fill the shock absorber to capacity, working the arm slowly up and down while adding fluid. Replace the filler plug using a new gasket if necessary. Connect the link assembly.

To remove the shock absorber from the car, remove the wheel if necessary, disconnect the link from the shock arm and remove the shock absorber from the frame.

To install the shock absorber, reverse the procedure for removal. When the installation is complete, check all screws and nuts to be sure they are tight. If necessary, paint the absorbers and fittings. Check the tire pressure.

To secure most satisfactory performance, keep the car springs well lubricated and the spring bolts and shackles free.

SHOCK ABSORBER INSPECTION (All Models)

• Shock absorbers should be inspected periodically. The following operations can be done on the car without disassembling the absorber.

1. Check for low fluid by determining if resistance is uniform through the complete stroke of absorber movement. A quick check can be made by bouncing each corner of the car up and down.

2. Check for worn or broken links or bushings. Check for excessive wear by moving the absorber arm slightly up and down to determine the tightness of bushings, or wear in link pins or link pin holes. Also check link or bushing wear by twisting the link with pliers or by prying the link connection with a screwdriver.

3. Fluid leakage can be easily determined by the presence of excessive fluid on the outside of the absorber. Remove the absorber for repair or replacement when this condition is present — refilling is only a temporary correction.

4. Broken or inoperative shock absorbers can be detected by the lack of absorber resistance or by too much resistance. Too much resistance may indicate broken parts, clogged valves or a frozen piston. No resistance may indicate lack of fluid, dirt holding the valve open, or a broken cam or internal parts. Broken or inoperative absorbers should be repaired or replaced.

5. A noisy shock absorber may be caused by any of the following items:

Worn or broken links or bushings

Shock absorber empty or nearly empty

Loose absorber mountings

If the trouble cannot be located by inspection, remove the absorber from the car for repair or replacement.

SPRING AND SHOCK ABSORBER DIAGNOSIS

CHASSIS SPRINGS SAG OR SPRING BOTTOMING.

CAUSES

1. Unusually severe operation or excessive overloading.
2. Improperly functioning shock absorbers.
3. Spring leaves broken.

CHASSIS SPRING NOISES.

CAUSES

1. Loose U-bolts permitting abnormal side movement of leaves and interference with metal covers.
2. Spring covers damaged, loose or improperly installed.
3. Axle to frame bumper not of correct type or omitted.
4. Sprung frame or bent frame horn causing misalignment of springs.

ABNORMAL CHASSIS SPRING BREAKAGE.

CAUSES

1. Unusually severe service or excessive overload.
2. Spring U-bolts loose (breakage near center bolt).
3. Spring center bolt loose (breakage at center bolt).
4. Tight spring shackle (breakage of main leaf near spring eye or breakage of spring eye).
5. Improperly functioning shock absorbers (breakage of main leaf).

SPRING SHACKLE NOISES.

CAUSES

1. Front spring bolts lack lubrication.
2. Spring shackle pins or hinge pins loose in spring ends or in frame brackets.
3. Spring hangers or frame horns loose on frame, bent or broken.

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BRAKE SECTION

GENERAL

• All "M" Series commercial cars are equipped with Wagner Lockheed Hydraulic, two-shoe brakes. When the foot pedals are applied a column of fluid is forced through special tubes to the brake assembly shoes by displacing the pistons in the wheel cylinders. The pistons force the brake shoes in contact with the drums and the equal pressure causes equal brake contact of the shoes and drums, thus making the system self-equalizing.

BRAKE SPECIFICATIONS

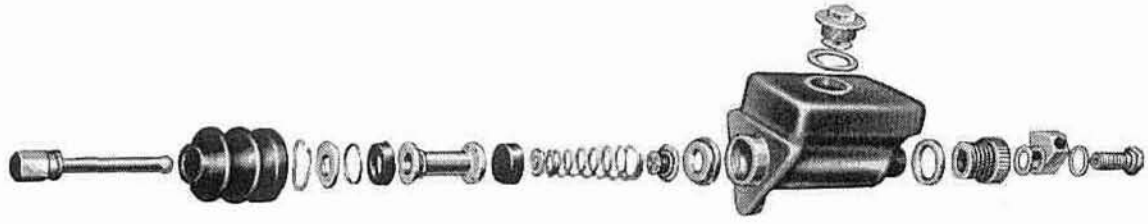
	Coupe Express	Standard	Heavy Duty
Front — Type	Lockheed Hydraulic	Lockheed Hydraulic	Lockheed Hydraulic
Rear — Type	Lockheed Hydraulic	Hi-Torque Hydraulic	Hi-Torque Hydraulic
Parking — Type	Rear Wheel—Shoe	Trans.—Band	Trans.—Band
Lining Material—Front and Rear	BB-64B Molded	BB-64B Molded	BB-64B Molded
Lining Material—Parking Brakes	BB-64B Molded	Asbestos Woven Fabric	Asbestos Woven Fabric
Lining Width — Front	2″ (50,8 mm)	2″ (50,8 mm)	2″ (50,8 mm)
Lining Width — Rear	2″ (50,8 mm)	2″ (50,8 mm)	3″ (76,2 mm)
Lining Width — Parking	2″ (50,8 mm)	2″ (50,8 mm)	2″ (50,8 mm)
Lining Thickness — Front	3/16″ (4,8 mm)	1/4″ (6,35 mm)	1/4″ (6,35 mm)
Lining Thickness — Rear	3/16″ (4,8 mm)	3/8″ (9,52 mm)	3/8″ (9,52 mm)
Lining Thickness — Parking	3/16″ (4,8 mm)	5/32″ (3,97 mm)	5/32″ (3,97 mm)
Total Braking Area — Front	78-3/4 (2 m)	103 (2,61 m)	110-1/2 (2,8 m)
Total Braking Area — Rear	78-3/4 (2 m)	113 (2,87 m)	169-1/2 (4,3 m)
Total Braking Area — Parking	78-3/4 (2 m)	49-1/4 (1,25 m)	49-1/4 (1,25 m)
Drum Size — Front	11 x 2 (279,4 x 50,8 mm)	13-1/8 x 2 (333,4 x 50,8 mm)	14 x 2 (355,6 x 50,8 mm)
Drum Size — Rear	11 x 2 (279,4 x 50,8 mm)	14-1/8 x 2 (358,7 x 50,8 mm)	14-1/8 x 3 (358,7 x 76,2 mm)
Drum Size — Parking	11 x 2 (279,4 x 50,8 mm)	8 x 2 (203,2 x 50,8 mm)	8 x 2 (203,2 x 50,8 mm)

BRAKE SERVICE TOOLS

926	Cylinder Hone
FL-114	No-Go Gauges
FL-304	Brake Cylinder Filler
J-1492	Bleeder Wrench

ALL MODELS Automatic hill holders are optional equipment on all models at extra cost. The hill holder prevents the return of the brake fluid from the brake wheel cylinders while the clutch pedal is depressed. Also, Bendix Brake Booster is available on Heavy Duty models as optional equipment.

MASTER CYLINDER



The parts of the master brake cylinder are shown in the order of their assembly.

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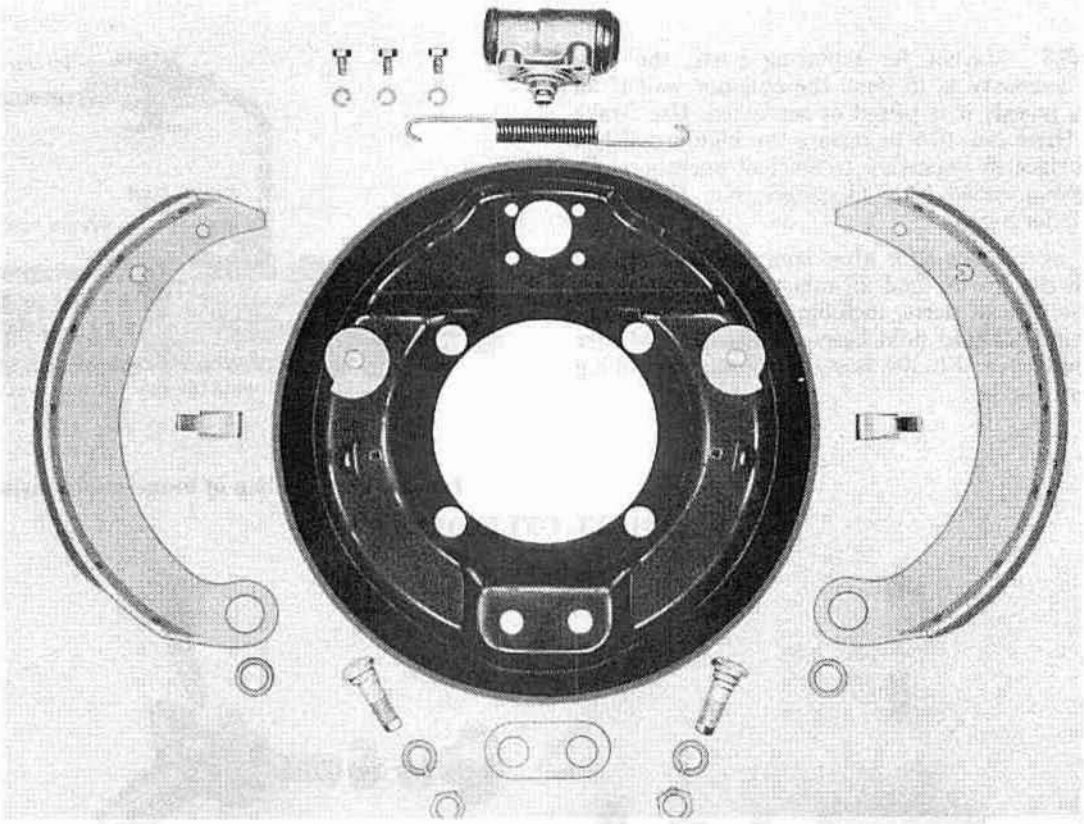
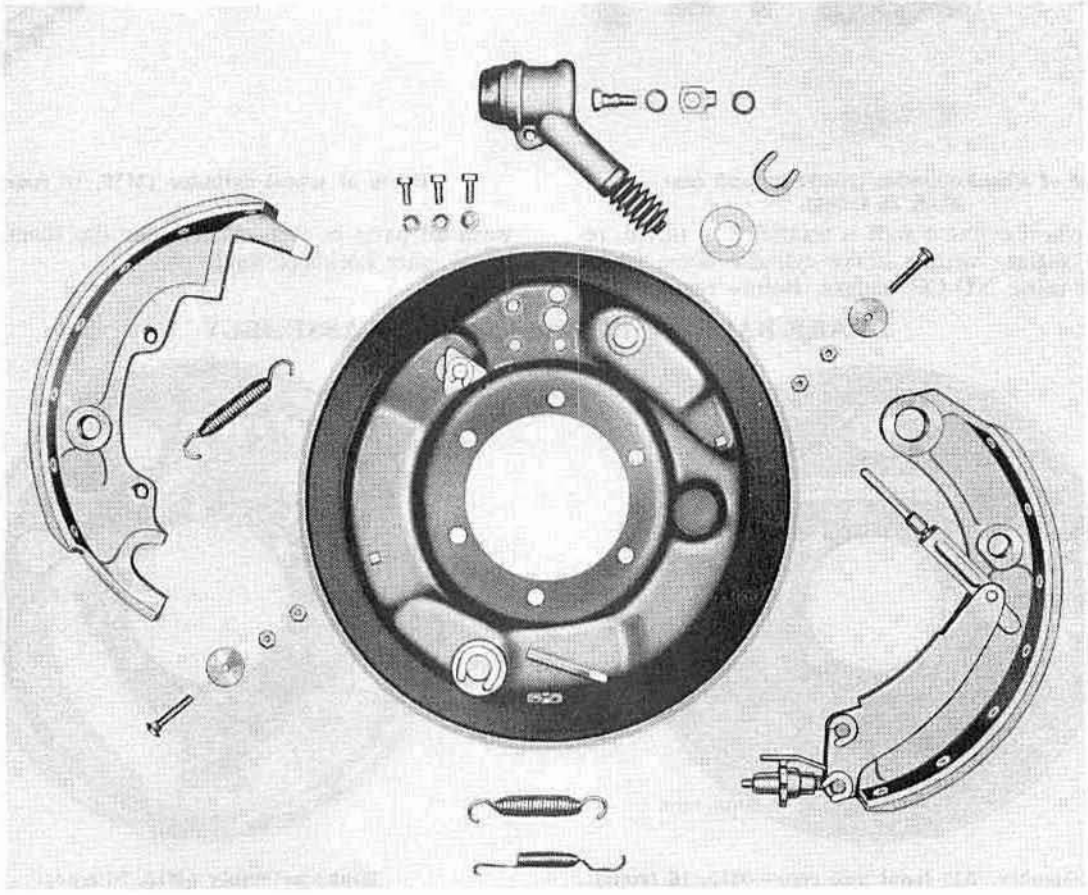


Brake assembly (M5 front and rear—M15, 16 front).



Brake assembly (M15, 16 rear).

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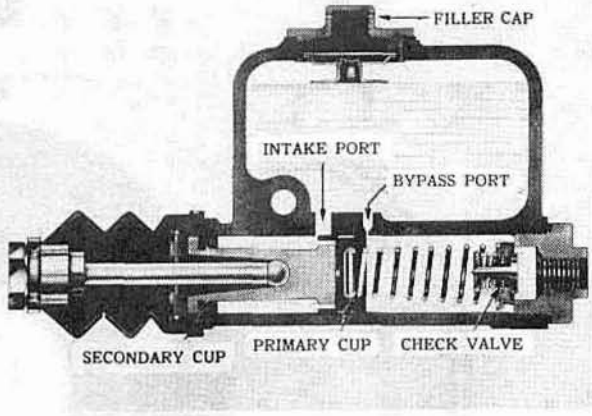
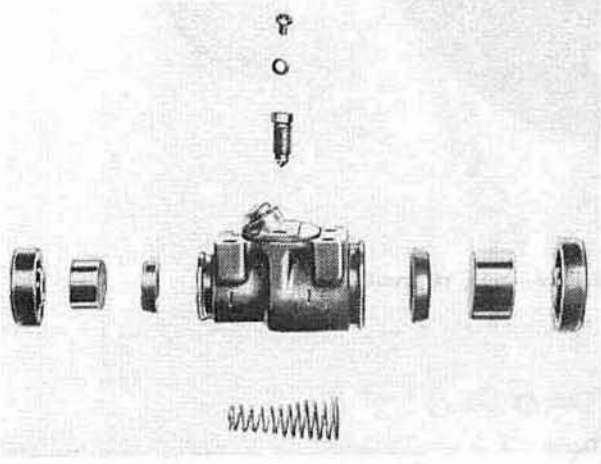
ALL MODELS Except for replacing parts, the only servicing necessary is to hone the cylinder wall if an inspection reveals it is pitted or scratched. Use Brake Cylinder Hone No. 926 to restore the highly polished smooth surface so important to efficient operation. Also use recommended NO-GO gauges, No. FL-114 to check cylinder bores.

Always install new cups after honing a brake cylinder. Wash the casting and all other parts in clean alcohol. Also dip all parts, including castings, in genuine Wagner Lockheed fluid before reassembly. Master cylinder filler No. FL-304 is recommended for filling the master cylinder.

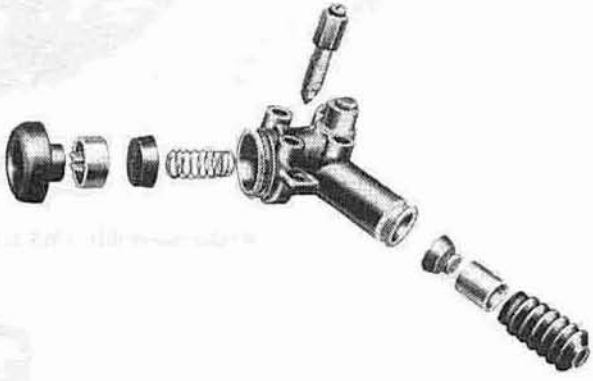


Internal construction of brake master cylinder.

WHEEL CYLINDER



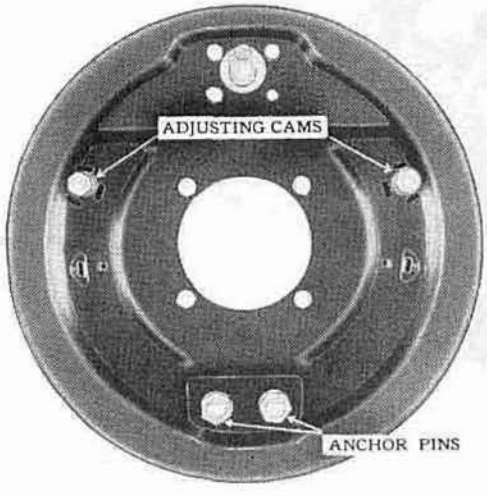
Parts of wheel cylinder (M5 front and rear — M15, 16 front).



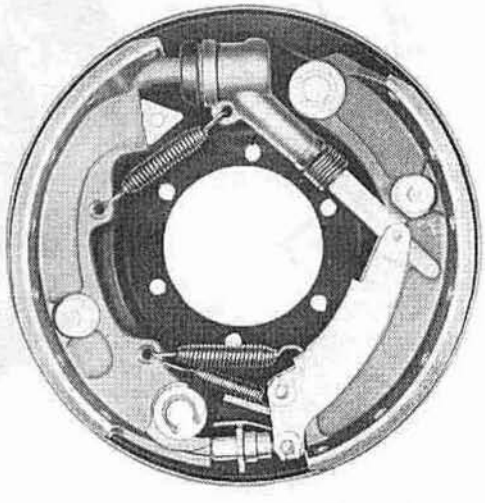
Parts of wheel cylinder (M15, 16 rear).

If the wheel cylinder wall is scratched or pitted, restore the surface with a brake cylinder hone. Check the bores using NO-GO gauges. Before reassembling wash all parts in clean alcohol and dip them in genuine Wagner Lockheed fluid.

BRAKE BACKING PLATE AND SHOE ASSEMBLY



Brake assembly (M5 front and rear—M15, 16 front).



Brake assembly (M15, 16 rear).

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HILL HOLDER

ALL MODELS On cars so equipped. When making a clutch pedal adjustment the hill holder to clutch pedal rod should also be adjusted. This is necessary to provide the release of the hill holder simultaneously with the engagement of the clutch.

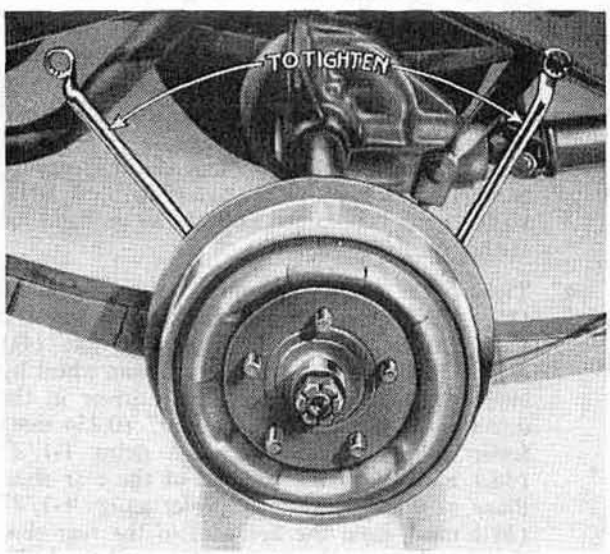
PARKING BRAKE ADJUSTMENT

COUPE EXPRESS Adjustment on both rear wheels is made through a single turnbuckle on the hand brake front cable assembly. Jack up the rear wheels. Set the hand brake two notches from the released position. Take the slack out of the cables with the turnbuckle until there is a light drag when turning the rear wheels. Then release the hand brake lever and see that the rear wheels are free from drag. If not, the adjustment should be repeated.

STANDARD AND HEAVY DUTY The hand or parking brake lever operates a band brake at the rear of the transmission. Adjustment is made as follows:

1. By means of the adjusting screws provided on the top, bottom and left side of the brake assembly, adjust the band to obtain 1/32" (0,793 mm) clearance between the lining and drum at all points. Care should be taken to make sure that the lock wire and lock nuts are properly reinstalled.

2. With the hand lever in the fully released position, adjust the front rod clevis so that when the hook on the rear rod is placed through the front rod clevis and the hole in the lower end of the rocker lever, it will take up all the slack in the cams without applying the brake. Reinstall the cotter key to complete the adjustment.

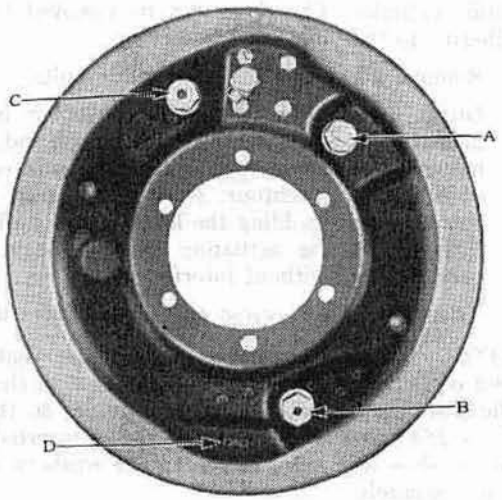


MINOR BRAKE ADJUSTMENT

FRONT BRAKES—STANDARD AND HEAVY DUTY; ALL BRAKES—COUPE EXPRESS Jack up the wheels, check the wheel bearings and adjust them if necessary. Turn each adjusting cam until the brake shoe drags, then back off until it is just free. To tighten, turn the cam in the direction of wheel rotation on the front side of the brake and in the opposite direction on the rear side (See illustration.)

IMPORTANT On Standard and Heavy Duty vehicles used for transporting heavy loads the shoe lining to drum clearance should be checked with a feeler gauge after any readjustment of the brakes. An accurate check can be readily made with the truck fully or partially loaded and with tires on the ground, as follows: With the brake drum feeler opening at the lower end of the brake lining, insert a feeler gauge between the drum and lining. There should be at least .005" (0,127 mm) clearance. Readjust as necessary to obtain correct clearance.

STANDARD AND HEAVY DUTY MODELS Rear brakes only — These adjustments should be carried out in the sequence outlined. First make sure the wheel bearings are in good condition and properly adjusted.



1. Loosen reverse anchor nut (A) sufficient to allow rotation of the anchor pin. Turn the anchor pin (A) in a forward wheel rotation direction with an adjustable wrench, until a brake drag is felt. Then back off anchor until the drag is just relieved. Lock the anchor nut securely.

2. Remove the adjusting hole cover at (D), insert a screw driver and rotate the star wheel, moving the handle of the screw driver in the direction of the axle until a brake drag is noticeable. Release the star wheel by moving the screw driver handle away from the axle until the drag is relieved. Replace the adjusting hole cover.

NOTE: Anchor pins (B) and (C) should not be disturbed unless new lining is installed, or other adjustments fail to give satisfactory results. Adjustments should only be made when the drums are at normal temperature.

RELINING BRAKE SHOES

ALL BRAKES — COUPE EXPRESS; FRONT BRAKES — STANDARD AND HEAVY DUTY When the brake shoes are to be relined, a wheel cylinder clamp, No. F-30, should be used to prevent the wheel cylinder pistons from being forced out resulting in a loss of the brake fluid or necessitating bleeding the lines.

To remove the brake shoes, remove the anchor pin, "C" washers, and plain washers. Remove the return spring and pull the shoes from the wheel cylinder

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pistons. Then pull off the shoes and on rear brakes, disconnect the parking brake cables.

• When relining the brake shoes, it is necessary that the following items receive careful attention:

1. Have a snug fit between the lining and the brake shoe.
2. Select rivets of proper size and material.
3. *Remove all high spots from the lining.*
4. On reinstallation, use new guide and anchor pin "C" washers.

STANDARD AND HEAVY DUTY—REAR BRAKES When removing the brake shoes from the dust shield for relining, it is important to eliminate any chance of scoring the cylinder wall so as to cause a fluid leak. To avoid possibility of damage, exercise great care in removing the lever actuating push rod from the small hydraulic cylinder. The shoes can be removed safely by adhering to the following instructions:

1. *Remove all spring and shoe guide bolts.*
2. Grasp the shoe actuating lever, which is attached to the shoe and actuating push rod, and move it in extreme applied position in direction of brake shoe contour. Rotate the brake shoe outward while holding the lever in this position. This allows the actuating shaft to leave the cylinder bore without interference.
3. To reassemble, reverse the above operations.

NOTE: When reassembling, make sure that the toe end of the front shoe web is in the slot of the hydraulic piston. Also adjust the shoe guides so that a .010" (0,254 mm) feeler gauge may be inserted between the shoe web and the shoe guide washers. Lock Jam nuts securely.

MAJOR BRAKE ADJUSTMENTS

ALL BRAKES — COUPE EXPRESS; FRONT BRAKES — STANDARD AND HEAVY DUTY Before proceeding with the major brake adjustment the following items should receive careful attention:

1. Check and adjust the front wheel bearings.
2. Check rear axle shaft end play. Tighten the backing plate bolts, and the front and rear spring "U" bolts.
3. Check wheel cylinders for proper installation. Inspect for leakage. Make the necessary replacements.

3a. *Coupe Express only* — Lubriplate parking brake linkage.

4. Check pedal adjustment.

COUPE EXPRESS After relining the brakes, it is necessary to readjust the eccentric anchor pin, or pins, to relocate the shoes within the drum. First, the drum diameter should be measured by the use of an approved brake gauge, such as the model F0. A similar gauge, No. F-1, is also recommended and available through the Tool and Equipment Division. After measuring the drum diameter, install the shoe adjusting fixture on the axle or spindle.

ALL BRAKES — COUPE EXPRESS; FRONT BRAKES — STANDARD AND HEAVY DUTY Loosen the anchor pin lock nut, or nuts, on the rear of the backing plate. Turn the eccentric pin and rotate the shoe adjusting cam until .005" (0,127 mm) clearance is obtained at the heel or lower end of the shoe and .010" (0,254 mm) clearance is obtained at the toe or upper end of the shoe. Clearances should be measured with a feeler gauge at a point about 1-1/2" (38,1 mm) from the ends of the lining. After the hub and drums are reassembled, the final adjustment is made by the usual minor brake adjustment previously described.

STANDARD AND HEAVY DUTY — REAR BRAKES.

1. Loosen rear shoe heel anchor pin nut (C), (see the illustration on the preceding page), the front shoe heel anchor pin nut (B) and reverse anchor nut (A) sufficient to allow rotation of the anchor pins. Then turn the anchor pins to their off position with an Allen wrench. These positions can readily be determined by observing shoe movement. Turn reverse anchor (A) to its off position with an adjustable wrench. Insert a heavy standard screw driver through adjustment hole, engage star wheel, and move handle away from the axle as far as possible while rotating star wheel. This position of anchors and shoes permits assembly of the hub and drum over newly relined shoes.

   Then proceed according to the following instruction. These steps must be followed in sequence, as outlined below.

2. Insert a .010" (0,254 mm) feeler gauge through inspection hole in drum approximately 1-1/2" (38,1 mm) from the toe end of the front shoe lining. Then rotate anchor pin (A) in a forward rotation of drum until feeler gauge is just free between the lining and drum.
3. Move feeler gauge and drum inspection hole to approximately 1-1/2" (38,1 mm) from heel end of front shoe lining. Rotate the anchor pin (B) outward until the feeler gauge is just free. Recheck toe end of the lining. If the clearance is not correct, repeat the operations until .010" (0,254 mm) is obtained at both the heel and toe of the front shoe lining.
4. Tighten the anchor pin nuts securely with an 18" (457,2 mm) box socket wrench. Insert a screw driver through the adjusting hole (D) in the dust shield and rotate the star wheel by moving the handle of the screw driver in the direction of the axle until a .010" (0,254 mm) feeler gauge is just free at a point 1-1/2" (38,1 mm) from the toe end of the rear shoe. Place a .010 (0,254 mm) feeler gauge 1-1/2" (38,1 mm) from the heel end of the rear shoe lining and rotate the anchor (C) until the feeler gauge is just free. Recheck the toe end of the lining. If the clearance does not check to .010" (0,254 mm), repeat the above operation until it is obtained at both the toe and heel of the rear shoe.

   Tighten the anchor pin nut securely with an 18" (457,2 mm) box wrench. Replace the adjusting hole cover at (D).

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BRAKES — DIAGNOSIS

PEDAL GOES TO FLOORBOARD.

CAUSES

1. Normal wear of lining.
2. Brake shoes not properly adjusted.
3. Leak in system.
4. Air in system.
5. Pedal improperly set.
6. No fluid in supply tank.

ALL BRAKES DRAG.

CAUSES

1. Mineral oil in system.
2. Pedal improperly set (insufficient play).

ONE WHEEL DRAGS.

CAUSES

1. Weak or broken brake shoe return spring.
2. Clogged or crimped hydraulic brake line.
3. Brake shoe bearing seized to anchor pin.
4. Brake shoe set too close to drum.
5. Piston cups distorted.
6. Loose wheel bearings.

CAR PULLS TO ONE SIDE.

CAUSES

1. Grease soaked lining.
2. Shoes improperly set.
3. Backing plate loose on axle.
4. Different makes of lining.
5. Tires not properly inflated.
6. Clogged or crimped hydraulic brake line.

SPRINGY, SPONGY PEDAL.

CAUSES

1. Brake shoes not properly adjusted.
2. Air in system.

EXCESSIVE PRESSURE ON PEDAL, POOR STOP.

CAUSES

1. Brake shoes not properly adjusted.
2. Improper lining.
3. Oil on lining.
4. Lining making partial contact.

OVERLY SENSITIVE BRAKES.

CAUSES

1. Brake shoes not properly adjusted.
2. Loose brake backing plates.
3. Grease soaked lining.

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WHEELS AND TIRES

WHEEL AND TIRE SPECIFICATIONS

Tire Sizes and Air Pressures

Coupe Express — Disc Wheels Only

FRONT AND REAR

Ply	Size	Pressure
4	*6.00x16	28# (1,97 Kgs.)
6	6.00x16	36# (2,53 Kgs.)
4	6.25x16	28# (1,97 Kgs.)
6	6.25x16	36# (2,53 Kgs.)
4	6.50x16	28# (1,97 Kgs.)
6	6.50x16	36# (2,53 Kgs.)
4	7.00x16	26# (1,83 Kgs.)
6	7.00x16	36# (2,53 Kgs.)

* — Standard Single Tires.

Standard — Spoke or Disc Wheels

	FRONT		SINGLE REAR		DUAL REAR	
Ply	Size	Pressure	Size	Pressure	Size	Pressure
6	*6.00x17	50# (3,5 Kgs.)	*6.00x17	50# (3,5 Kgs.)	†6.00x17	50# (3,5 Kgs.)
6	6.50x17	50# (3,5 Kgs.)	6.50x17	50# (3,5 Kgs.)	6.50x17	50# (3,5 Kgs.)
8	7.00x17	55# (3,86 Kgs.)	7.00x17	55# (3,86 Kgs.)	7.00x17	55# (3,86 Kgs.)
8	7.50x17	55# (3,86 Kgs.)	•7.50x17	55# (3,86 Kgs.)	7.50x17	55# (3,86 Kgs.)
6	6.00x20	50# (3,5 Kgs.)	6.00x20	50# (3,5 Kgs.)	6.00x20	50# (3,5 Kgs.)
6	6.50x20	50# (3,5 Kgs.)	6.50x20	50# (3,5 Kgs.)	6.50x20	50# (3,5 Kgs.)
8	30x5	70# (4,9 Kgs.)	30x5	70# (4,9 Kgs.)	30x5	70# (4,9 Kgs.)
8	32x6	65# (4,9 Kgs.)	32x6	65# (4,56 Kgs.)	32x6	65# (4,56 Kgs.)
8	7.00x20	55# (3,86 Kgs.)	7.00x20	55# (3,86 Kgs.)	7.00x20	55# (3,86 Kgs.)
10	‡32x6	70#	32x6	70# (4,9 Kgs.)	‡32x6	70#
8	‡7.50x20	55#	7.50x20	55# (3,86 Kgs.)	‡7.50x20	55#
10			8.25x20	60# (4,22 Kgs.)		
10			34x7	75# (5,27 Kgs.)		
10			9.00x20	65# (4,56 Kgs.)		
12			9.00x20	70# (4,9 Kgs.)		

* — Standard Single Tires.
† — Standard Dual Tires.
‡ — On special request — recommended only when road conditions call for oversize tires.
• — Largest Tire with Pick-Up Box.

Heavy Duty — Spoke or Disc Wheels

	FRONT		SINGLE REAR		DUAL REAR	
Ply	Size	Pressure	Size	Pressure	Size	Pressure
6	†*6.00x20	50# (3,5 Kgs.)			†6.00x20	50# (3,5 Kgs.)
6	6.50x20	50# (3,5 Kgs.)			6.50x20	50# (3,5 Kgs.)
8	30x5	70# (4,9 Kgs.)			30x5	70# (4,9 Kgs.)
8	32x6	65# (4,56 Kgs.)	*32x6	65# (4,56 Kgs.)	32x6	65# (4,56 Kgs.)
8	7.00x20	55# (3,86 Kgs.)	7.00x20	55# (3,86 Kgs.)	7.00x20	55# (3,86 Kgs.)
10	32x6	70# (4,9 Kgs.)	32x6	70# (4,9 Kgs.)	32x6	70# (4,9 Kgs.)
8	7.50x20	55# (3,86 Kgs.)	7.50x20	55# (3,86 Kgs.)	7.50x20	55# (3,86 Kgs.)
10			8.25x20	60# (4,22 Kgs.)	8.25x20	60# (4,22 Kgs.)
10	34x7	75# (5,27 Kgs.)	34x7	75# (5,27 Kgs.)	34x7	75# (5,27 Kgs.)
10	8.25x20	60# (4,22 Kgs.)	9.00x20	65# (4,56 Kgs.)		
12			10.00x20	70# (4,9 Kgs.)		
12			11.00x20	70# (4,9 Kgs.)		

* — Standard Single Tires.
† — Standard Dual Tires.

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WHEELS AND TIRES DIAGNOSIS

FRONT TIRES WORN ABNORMALLY.

CAUSES

1. Tires under inflated.
2. Incorrect front wheel toe-in.
3. Tire run-out or wobble in excess of 1/8" due to:
   - A. Tires improperly mounted.
   - B. Wheel stud nuts drawn up unevenly.
   - C. Sprung wheel.
4. Excessive front wheel camber.
5. Harsh or unnecessary use of brakes.
6. Improperly adjusted front wheel brakes (dragging).
7. Eccentric front wheel brake drums.
8. Tire eccentricity (in excess of 1/16").
9. Front wheel, hub, brake drum and tire out of balance.

FRONT WHEEL NOISES.

CAUSES

1. Wheel rattles resulting from:
   - A. Loose bearings.
   - B. Broken or pitted bearings.
   - C. Brake drums loose on hub.
   - D. Brake shoe or backing plates loose.
   - E. Hub caps loose in wheel hub.
   - F. Hub cover retaining spring broken and loose in wheel hub.
2. Wheel squeaks resulting from:
   - A. Wheel stud nuts loose or unevenly drawn up.
   - B. Slight movement of brake drums on hubs.
   - C. Dust washer retainer sprung or broken.
   - D. Lack of lubrication of front wheel bearings.
   - E. Front wheel bearings adjusted too tightly.
   - F. Front wheel bearing broken or pitted.
3. Variation in tire tread surface due to repaired section or broken place in casing.
4. Type or condition of tire tread (noise similar to a gear growl).
5. Under inflated tires (noise similar to a gear growl).
6. Foreign object imbedded in tire tread.

ABNORMAL HEATING OF FRONT WHEEL BEARINGS.

DESCRIPTION

Front wheel bearings, when correctly adjusted and lubricated, will give off considerable heat after the car has been in operation for some time. The service man should not become alarmed if the wheel hubs are warm immediately after extended use of the car.

CAUSES

1. Insufficient lubricant.
2. Use of a poor quality or incorrect grade of lubricant.
3. Bearings adjusted too tightly.
4. Bearings broken or pitted.
5. Heat transfer from brake drums due to dragging brakes.
6. Foreign particles such as dirt, grit, etc. in bearings.
7. Dragging front wheel brakes or abnormal use of the brakes.
8. Steering knuckle spindle bent.
9. Eccentric front wheel hub.
10. Very tight felt lubricant seal.

REAR TIRES ABNORMALLY WORN.

CAUSES

1. Tires under inflated.
2. Rear wheels out of alignment, due to:
   - A. Rear axle housing sprung or broken.
   - B. Rear spring center bolt broken or sheared permitting rear axle housing to shift on rear spring.
   - C. Broken rear spring main leaf.
   - D. Use of incorrect rear spring or rear spring main leaf.
   - E. Chassis frame bent or broken in rear.
3. Rear wheel run-out or wobble, due to:
   - A. Wheel stud nuts loose or drawn up unevenly.
   - B. Wheel or rim distorted.
   - C. Rear axle shaft bent or sprung.
   - D. Rear wheel loose on axle shaft.
   - E. Rear wheel hub does not fit shaft taper.
4. Harsh and unnecessary use of brakes.
5. Sustained high speed driving (especially on curves).
6. Tire tread not concentric with axle shaft center.
7. Wheel, hub, drum and tire assembly out of balance.

REAR WHEEL AND REAR WHEEL BEARING NOISE.

CAUSES

1. Rear wheel noise, resulting from:
   - A. Wheel loose on axle shaft taper (does not fit taper or loose shaft nut).
   - B. Wheel key way or axle shaft badly worn.
   - C. Wheel hub and drum stud nuts loose.
   - D. Interference of brake drum with brake shoes.
   - E. Interference of axle shaft with wheel bearing felt retainer.
   - F. Brake backing plate loose.
2. Rear wheel bearing noise, resulting from:
   - A. Insufficient lubrication.
   - B. Use of poor quality or incorrect grade of lubricant.
   - C. Wheel bearing cup or cone rough, scored or brinnelled.
   - D. Wheel bearing rollers chipped, cracked, worn flat, etc.
   - E. Wheel bearing improperly adjusted (excessive axle shaft end play).
3. Type or condition of tire tread (noise similar to rear axle gear noise).

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PREPARING FOR DELIVERY

• The object of inspecting and servicing the new truck before delivery to the retail customer is to assure its delivery in such condition that the new owner derives the maximum satisfaction and pride of ownership from the very start.

Extraordinary care is exercised at the factory to insure the proper operation of all instruments and controls — to see that each part is properly fitted or adjusted; that each bolt, nut, and coupling is properly anchored — but, new parts do not always operate freely nor retain their original "set" or adjustment. Because of these facts, together with derangements that may occur in shipping, it is vitally essential to inspect thoroughly and service each new truck before delivery.

Service on the truck starts with the preparation of the new truck for delivery to the purchaser — and this service operation carries serious responsibilities.

First impressions are often lasting impressions and in the preparation of the new truck for delivery, the dealer's service department has the first opportunity to convince the owner of their ability and thoroughness. There is no more opportune time to "clinch a customer for good" than when initially servicing his truck. He may not know all about the painstaking detail in getting his truck ready for him, but he is going to be able to tell whether or not noticeable operations were slighted — whether or not the truck performs as it should from the time he drives it out the door.

Revised February 1946.

Properly servicing the new truck before delivery insures the new owner "getting off to a good start." He is not going to be troubled with those minor annoying conditions that invariably follow when the truck is not serviced at all or, when this operation is only casually performed. He is not going to have to make frequent and repeated trips to the service station to have this, and that, or some other minor condition corrected. Having to return repeatedly to the service station during the early period of ownership not only dampens the customer's enthusiasm, but it is also costly to any dealer organization to handle new truck service in this manner.

As the new truck leaves the factory, a copy of Form No. H350 (illustrated on page 91) — entitled "Preparation of New Car for Retail Delivery," is placed in the package compartment. One side of Form No. H350 applies to the new truck as designated at the top of the form. Complete instructions on the procedure for using Form No. H350 are included.

It is important also that Post Card Form No. H353, which is also placed in the package compartment, be filled in completely, and promptly mailed to the factory where it will be retained as a permanent delivery and history record, valuable in the handling of subsequent correspondence.

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7-16-45
H350

Studebaker

PREPARATION OF NEW CAR FOR RETAIL DELIVERY

This side used for COMMERCIAL CAR—See other side for passenger car

INSTRUCTIONS: Made by dealer at the time of preparing new commercial car for delivery. When completed, detach the stub and tie it securely to the steering wheel. File the remaining section according to serial number of the car in the New Car Preparation Department, and when car is sold, transfer to purchaser's file in service department.

Delivered to_____ Address_____

Serial No._____ Engine No._____ Key No._____

SUGGESTED SEQUENCE OF OPERATIONS

Inflate all tires to recommended pressure	Fill radiator	Install anti-freeze if needed

RAISE CAR FOR INSPECTION AND LUBRICATION

LUBRICATION	INSPECTION	
General chassis lubrication	For oil, water and gasoline leaks	All steering connections for tightness and proper assembly
Rear axle (if necessary)	All sheet metal bolts, cab holddown bolts and body bolts for looseness	Chassis spring U bolts for tightness
Transmission (if necessary)		For due wheel tire run-out or wobble
Front and rear wheel bearings	All wheels for free running brake shoe clearance	Bumper bars for looseness

INSPECT AND ADJUST WHEN NECESSARY

Engine crankcase oil level	Spark modifier for operation and complete retard at idle speed	All wheel hub or rim nuts for tightness
Water level in storage battery, gravity reading, connections and hold down bolts	Ignition timing with flywheel or vibration damper markings and set octane selector	Hubcovers for proper installation
Fan belt adjustment		With front wheels in straight ahead position check steering wheel to see if cam lever shaft is on high spot of cam
Condition of carburetor air cleaner filter	Accelerator pedal travel for full throttle opening and overdrive kickdown switch operation (if equipped)	Front wheel toe-in
Choke for free linkage movement and proper closing.		Head lamps for aim (focus)
Manifold heat valve for free operation	All wire connections, generator, air cleaner, radiator brace, hood support rod, and hood side panels for looseness	All lights and horn operation
Distributor point gap		

DRIVING TEST

Starter operation	Operation of gear shift in all forward speeds and reverse	Hill-holder for simultaneous release with clutch engagement
Operation of all gauges on instrument panel	Operation of all accessories	Engine, transmission and rear axle for unusual noise
Windshield wiper operation	Shock absorber adjustment and operation	Squeaks or rattles
Brake operation including booster		
Clutch operation		

IMMEDIATELY AFTER SHUTTING ENGINE OFF

Inspect for engine oil leaks	Tighten manifold bolts	Correct any unusual condition disclosed during driving test
Tighten cylinder head bolts in recommended order		

FINAL

Test doors and windows for proper operation	Check tools and pack in proper compartment	Wash and polish vehicle excluding glass and plated parts
Test keys for proper operation	Install floor mat	Write serial number on Service Policy and deliver to office
Examine thoroughly for all shortages	Remove covering from upholstery and clean where necessary	

Lubricated by_____ Inspected by_____ Adjustments made by_____

Repair Order No._____ Date_____ Signed_____
New Car Delivery Department

This car Serial No._____ was prepared for retail delivery on Repair Order No._____

Signed_____
New Car Delivery Department

(Continued from reverse side)

Remarks_____

Selling Dealer's Name_____ Address_____

City_____ State_____

(Fold on this line, but do not detach.)

Place 1-Cent Stamp Here

GENERAL SERVICE DEPARTMENT
Truck and National Accounts Division
THE STUDEBAKER CORPORATION
SOUTH BEND 27, INDIANA

H353

IMPORTANT: Immediately on delivery of a commercial car this POST CARD is to be filled out on both sides by dealer, folded with corners tucked in slots and mailed to the factory.

Serial No._____ Engine No._____ Key No._____ Date Delivered to Owner_____

Owner's Name_____ Address_____

City_____ State_____ Kind of Business_____

This commercial car was prepared for retail delivery per Form H350 on Repair Order No._____

List any change in equipment made after dealer or owner took delivery of the vehicle.

If Trailer is Used, State: Trailer Make_____ Length_____ Unloaded Weight_____

Kind Material to be Carried_____ Weight of Average Payload_____ Average Daily Mileage_____

Type of Roads_____ Percent City Hauls_____ Percent Highway Hauls_____

Average Speeds_____ Will Owner Drive the Commercial Car?_____

Remarks_____

(Over)

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LUBRICATION

STUDEBAKER TRUCK LUBRICATION CHART

M5 M15 M15A M16

CRANKCASE DRAINING. Engine oil should be changed at the end of the first 500 miles and again after the first 1500 miles of operation. After this period, the oil should be changed regularly, the frequency depending on the condition of the oil as affected by operating and atmospheric conditions.

OIL LEVEL IN CRANKCASE. Oil level gage is marked to indicate oil level in crankcase. Add oil before the level drops to the point marked "Add Oil." Do not carry the oil level above the "Full" mark.

Speed during the first 300 miles (804 km.) of driving should not exceed 25 miles (40.3 km.) per hour.

OIL PAN CAPACITY

	M5	M15	M15A	M16
U. S. Quarts	5	5	5	6
Imperial Quarts	4.14	4.14	4.14	5
Liters	4.73	4.73	4.73	5.68

ENGINE OIL

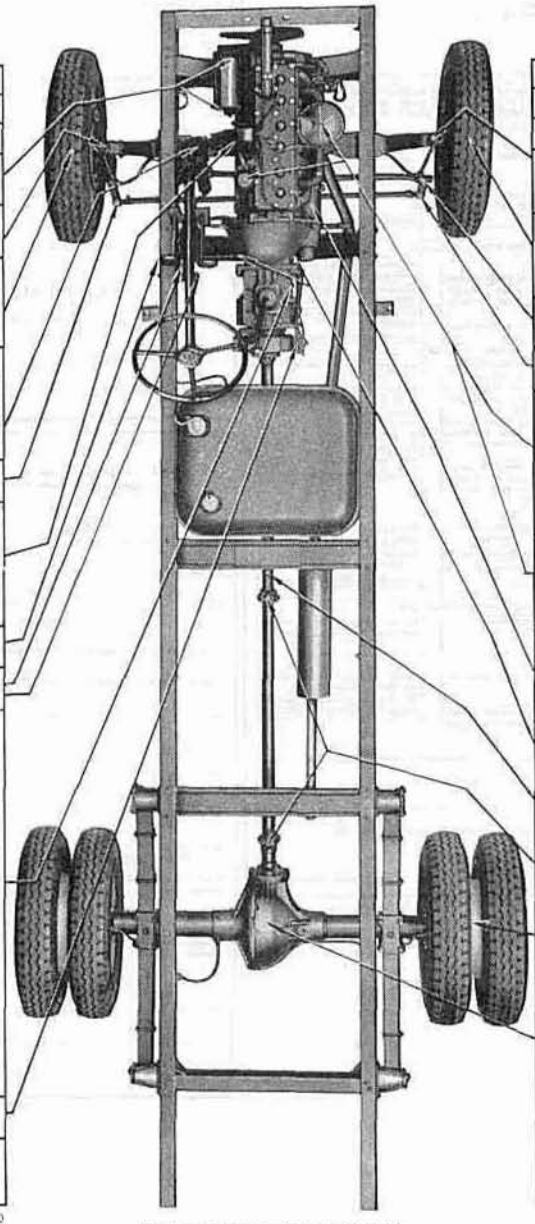
WINTER
Lowest temperature anticipated is below - 10° F. — USE SAE 10
Lowest temperature anticipated is - 10° F. — USE SAE 20

SPRING AND FALL
Lowest temperature anticipated is - 32° F. — USE SAE 30

SUMMER
Average temperature up to + 90° F. — USE SAE 30

High speed or hard pulling and temperature above + 90° F. — USE SAE 40

Under conditions where an S.A.E. 20 is specified, it is satisfactory to use an oil labeled 20W and S.A.E. 20. In case of an S.A.E. 10 engine oil, it is satisfactory to use one labeled 10W and S.A.E. 10.



The above illustration is of an M15 model.

The lubrication periods established are for average use and should be changed to suit individual operating conditions.

10,000 MILES (16.090 Km.)
5,000 MILES (8.046 Km.)
1,000 MILES (1.609 Km.)

1,000	5,000	10,000	
	★		GENERATOR. Engine oil S.A.E. No. 20.
		★	STEERING KNUCKLE. Chassis lubricant.
★			FRONT WHEEL BEARINGS. Remove the front wheel and bearings and pack the bearings with wheel bearing lubricant. Install the wheel and adjust the bearings. Do not fill the hub cap.
	★		STEERING GEAR. Fill through lubricant fitting with a recommended steering gear lubricant (light for winter, heavy for summer). Fill housing slowly to allow air to escape through vent hole in steering post jacket. Fill until lubricant runs out of vent hole.
		★	STEERING TIE ROD. Chassis lubricant.
	★		DISTRIBUTOR. Remove the distributor cover and the rotor. Place from two to four drops of S.A.E. No. 20 engine oil on the exposed wick. Lubricate the distributor shaft by means of the grease cup using wheel bearing lubricant. Put small amount of vaseline on cam.
		★	CLUTCH OPERATING SHAFT. Chassis lubricant.
			PEDAL SHAFT AND LINKAGE. Engine oil.
★	★		TRANSMISSION. CHECK LEVEL — DRAIN AND FLUSH. On M15, M15A, and M16 models inspect and fill to level of filler plug hole (right side) with S.A.E. No. 90 gear lubricant for air temperatures below + 32° F. (0° C.) and S.A.E. No. 140 gear lubricant for temperatures above + 32° F. (0° C.). M5 — For conventional transmission use S.A.E. No. 90 gear lubricant both for summer and winter. For *Overdrive Transmission* — Use only a high grade mineral oil gear lubricant of S.A.E. No. 90 viscosity for both summer and winter. If high grade mineral oil gear lubricant is not available, use S.A.E. No. 50 engine oil for summer and winter. Do not use gear lubricants containing any extreme pressure ingredients, such as lead, sulphur, or chlorine compounds.
		★	PARKING BRAKE LINKAGE. Lubricate with engine oil.
			DISC-TYPE PARKING BRAKE. *(Optional M16).* Chassis lubricant through four (4) lubricant fittings and engine oil on linkage.

SPEEDOMETER CABLE. Lubricate every 10,000 miles (16,090 km.) with S.A.E. No. 90 mineral oil. Check for leakage where speedometer cable enters transmission.

10,000 MILES (16.090 Km.)
5,000 MILES (8.046 Km.)
1,000 MILES (1.609 Km.)

1,000	5,000	10,000	
	★		STEERING KNUCKLE. Chassis lubricant.
		★	FRONT WHEEL BEARINGS. Remove the front wheel and bearings and pack the bearings with wheel bearing lubricant. Install the wheel and adjust the bearings. Do not fill the hub cap.
	★		STEERING REACH ROD. Chassis lubricant. (2 fittings.)
	★		STEERING TIE ROD. Chassis lubricant.
			CARBURETOR AIR CLEANER. Service regularly to avoid serious damage to engine parts. Where dust conditions prevail, it may be necessary to service the unit daily; or more often under severe dust conditions. To service, remove cleaner, wash filter element in kerosene and drain thoroughly. Clean oil reservoir and refill to indicated level with same grade oil used in engine. Reinstall cleaner.
		★	OIL FILLER CAP. Service every 1,000 miles (1,609 km.) or daily if dust conditions are severe. Wash the element in gasoline or kerosene and blow out with compressed air.
	★		STARTER MOTOR. Lubricate with two to four drops of engine oil (S.A.E. No. 20). The starter motor is located on the right of M5, M15, and M15A and on the left side of M16 models.
		★	CLUTCH RELEASE SHAFT. Engine oil.
		★	PROPELLER SHAFT SPLINES. Chassis lubricant.
		★	UNIVERSAL JOINTS. Chassis lubricant.
		★	REAR WHEEL BEARINGS. *M15, M15A,* and *M16* — Remove the wheels and spread wheel bearing lubricant directly on the bearings and in the hub. Install the wheels and the bearings. *M5* — Wheel bearing lubricant (see text).
★	★	★	REAR AXLE. CHECK LEVEL — DRAIN AND FLUSH. M5 — Use Studebaker hypoid lubricant or any reputable S.A.E. No. 90 hypoid lubricant. DO NOT MIX brands of hypoid lubricants. M15, M15A, and M16 — Use S.A.E. No. 90 gear lubricant for temperatures below + 32° F. (0° C.) and S.A.E. No. 140 for temperatures above + 32° F. (0° C.).

OIL FILTER. The filter is provided with a replaceable filter cartridge which should be replaced whenever the oil on the oil level gage appears dirty or contaminated.

WATER PUMPS. On all models the water pump is prepacked with lubricant.

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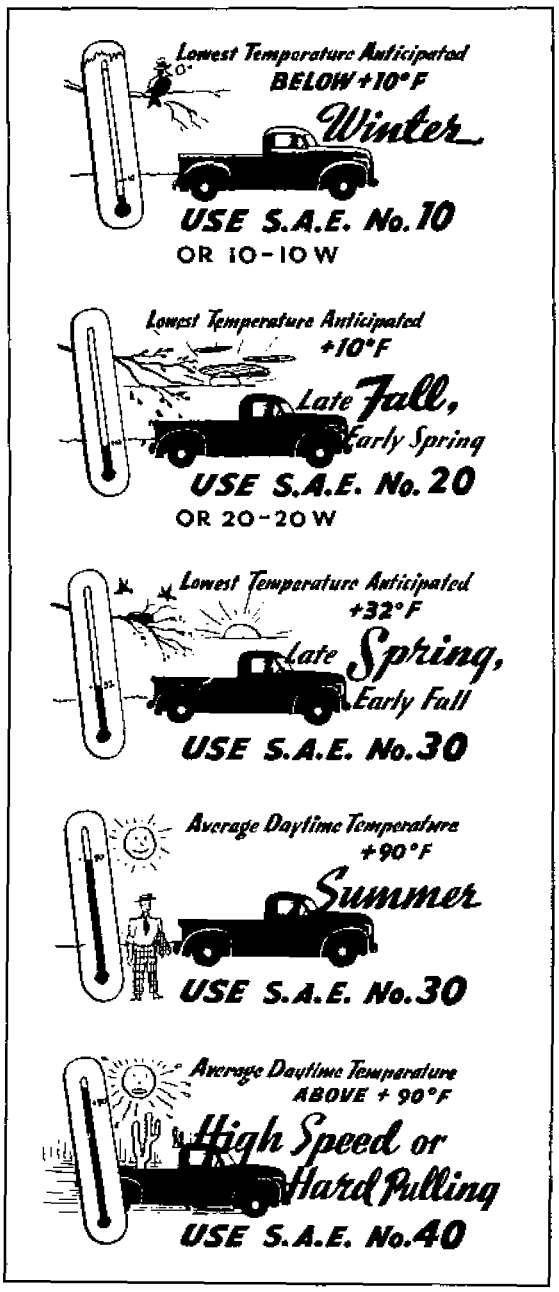

Engine Oil Chart.

CHASSIS LUBRICANT

Use only a high grade pressure lubricant, produced by a reputable oil company.

WHEEL BEARING LUBRICANT

Use a high grade, high melting point wheel lubricant — the product of a reputable oil company.

TRANSMISSION LUBRICANT

M5 CONVENTIONAL Use S. A. E. No. 90 gear lubricant for both summer and winter. Drain, flush, and refill every 10,000 miles (16.090 km) of operation.

M5 OVERDRIVE Use only a high grade mineral oil gear lubricant of S. A. E. No. 90 viscosity for both summer and winter. Avoid use of gear lubricants containing any extereme pressure ingredients such as lead, sulphur or chlorine compounds. If a high grade mineral oil gear lubricant is not available, use S. A.E. No. 50 engine oil for both summer and winter.

When changing lubricant, the transmission and overdrive cases must be drained. After flushing, the main case and overdrive case should be filled separately.

TRANSMISSION LUBRICANT (4-SPEED)

ALL MODELS Use S. A. E. No. 140 lubricant for summer, and S. A. E. No. 90 for winter. Drain, flush, and refill every 10,000 miles (16.090 km) of operation. Under severe operating conditions, change more frequently.

REAR AXLE LUBRICANT

M5 Use Studebaker hypoid lubricant, or any S.A.E. No. 90 hypoid lubricant produced by a reputable oil company. DO NOT MIX various brands of hypoid lubricants. If the brand is changed, drain and flush the rear axle housing thoroughly before refilling with new lubricant. Be sure to perform a thorough flushing job. Use light engine oil for flushing — do not use kerosene.

M15, M15A, AND M16 Use S. A. E. No. 140 gear lubricant for summer and S. A. E. No. 90 lubricant for winter. Drain, flush, and refill every 10,000 miles (16.090 km) of operation. Under severe operating conditions, change more frequently.

PROPELLER SHAFT LUBRICATION

M15, M15A, AND M16 Midship bearings are prepacked. See text, page 63, for lubrication of needle bearings and propeller shaft splines.

STEERING GEAR LUBRICANT

Lubrication is important to prevent gear wear and noise. Lubricate through the grease fitting in the steering gear housing cover. Fill the housing slowly to allow air to escape through the vent hole in the lower end of the steering post jacket. Most reputable oil companies carry a good grade of steering gear lubricant, but be careful that only a lubricant of correct specifications is obtained. A complete list of approved steering gear lubricants is available on request from the Ross Gear and Tool Co. of Lafayette, Indiana or the General Service Department, South Bend 27, Indiana. Avoid use of cup grease, graphite, white lead, or heavy solidified oil.

BODY AND MISCELLANEOUS LUBRICATION POINTS

Lubricate rotary door locks with a dry lubricant such as "Door-Ease" or powered graphite.

The internal parts of the rotary door lock should be lubricated with powdered graphite at 5,000 miles (8.046 km) intervals.

Lubricate door glass runs with a graphite pencil.

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FRAME SECTION

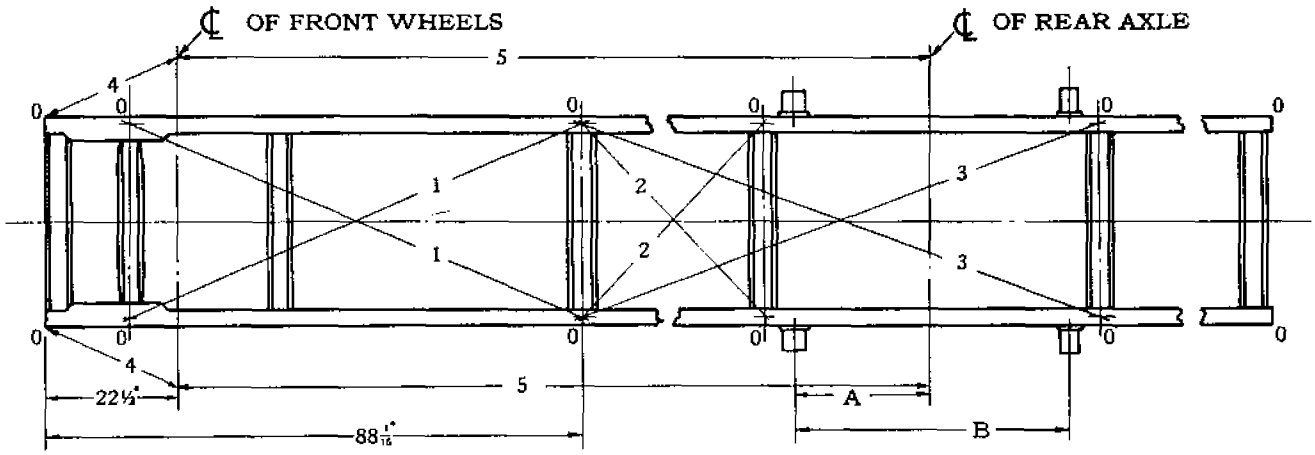
GENERAL

• The frame is the structural center of any vehicle — for, in addition to carrying the load, it provides and maintains the correct relationship between other units to assure their normal function and freedom of operation. The frame, due to its rugged design, requires very little attention to maintain its dependability.

Vehicles which have been in a collision, upset or accident of any nature which might result in a "swayed" or sprung frame, should always be carefully checked for proper frame alignment in addition to correct steering geometry and axle alignment.

CHECKING FRAME ALIGNMENT — ALL MODELS

Model	M5	M15	M15	M16	M15	M16	M16
Wheelbase	113"	120"	128"	128"	152"	152"	192"
Side Rail Height	7 1/16" (179,4 mm)	7 31/32" (202,4 mm)	8 1/16" (204,8 mm)	8 1/16" (204,8 mm)	8 1/8" (206,4 mm)	8 1/8" (206,4 mm)	8 3/16" (208 mm)
Side Rail Width	2 1/64" (51,2 mm)	2 21/64" (59,13 mm)	2 3/8" (60,3 mm)	2 3/8" (60,3 mm)	2 13/32" (61 mm)	2 13/32" (61 mm)	2 7/16" (62 mm)
Side Rail Thickness	.1406" (3,57 mm)	.1406" (3,57 mm)	.1875" (4,8 mm)	.1875" (4,8 mm)	.21875" (5,6 mm)	.21875" (5,6 mm)	.250" (6,35 mm)
Number of Crossmembers	6	6	6	6	7	7	8
Width of Frame	33 15/16" (862 mm)	33 15/16" (862 mm)	34 1/32" (864,4 mm)	34 1/32" (864,4 mm)	34 3/32" (866 mm)	34 3/32" (866 mm)	34 5/32" (868 mm)
Height of Side Rail at Rear	3 31/32" (101 mm)	4 31/32" (126 mm)	5 1/16" (129 mm)	5 1/16" (129 mm)	5 1/8" (130 mm)	5 1/8" (130 mm)	8 3/16" (208 mm)
Total Length of Frame	163" (4140 mm)	183 1/2" (4661 mm)	191 1/2" (4864 mm)	191 1/2" (4864 mm)	226 1/2" (5753 mm)	226 1/2" (5753 mm)	301" (7645 mm)
Rear Crossmember at End of Frame	Yes	No	No	No	Yes	Yes	Yes
Dimension A	25 3/8" (644 mm)	22 1/8" (562 mm)	22 1/8" (562 mm)	22 1/8" (562 mm)	22 1/8" (562 mm)	22 1/8" (562 mm)	22 1/8" (562 mm)
Dimension B	49 3/4" (1264 mm)	44 15/16" (1141 mm)	44 15/16" (1141 mm)	44 15/16" (1141 mm)	44 15/16" (1141 mm)	44 15/16" (1141 mm)	44 15/16" (1141 mm)



The most convenient way to check frame alignment, particularly where the body is on the chassis, is by marking on the floor all points from which measurements should be taken. This can be done by tacking or cementing pieces of paper securely to the floor under each point of measurement, and dropping a "plumb bob" from each point "O" indicated on the frame drawing. Satisfactory checking is dependent upon the accuracy of the marks with relation to the frame.

After each point shown has been marked carefully and the vehicle moved away from the layout on the floor, proceed as directed in the following paragraphs:

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1. Check frame width at front and rear ends using corresponding marks on the floor. If widths correspond to specifications given, draw a center line the full length of the vehicle halfway between the marks indicating front and rear widths. If the frame width is not correct, lay out the center line as directed in paragraph 4.
2. With the center line properly laid out, measure the distance from it to opposite points marked over entire length of chassis. If frame is in proper alignment, measurements should not vary more than 1/8" (3,175 mm) at any station.
3. To locate the point at which the frame is sprung, measure diagonals marked 1, 2 and 3. If diagonals in each pair are within 1/8" (3,175 mm), that part of the frame included between the points of measurement may be considered in satisfactory alignment, and these diagonals should intersect within 1/8" (3,175 mm) of the center line. Variations of more than 1/8" (3,175 mm) indicate misalignment.
4. If the center line cannot be laid out from the center points of the ends of the frame, it can be drawn through the intersection of any one pair of equal diagonals and the center point of one end of the frame or through points of intersection of any two pairs of equal diagonals. If the extreme front end, or horn, of the frame is damaged, the center of the front end of the frame can be located from a point exactly midway between the radiator brush guard support bolts.
5. After it has been determined that the frame is properly aligned, alignment of the front axle with the frame can be checked as directed below:
   a. The front axle is square with the frame if 4 equals 4, and 5 equals 5.
   b. The front axle has shifted sideways if the 4's or 5's are not equal.
   c. The front axle is bent, twisted or has one end shifted if 4 (right) is less than 4 (left) and 5 (right) is greater than 5 (left), or vice versa.

FRAME STRAIGHTENING — ALL MODELS

All straightening of frame members should be done cold. Use of heat is not recommended when straightening frame because heat weakens the structural characteristics of the frame members. Frame members which are bent or buckled sufficiently to show strains or cracks after straightening should be replaced.

Cutting, Reinforcing, Riveting and Welding

Whenever cutting of the frame is necessary, the rail should be cut at an angle of 45 degrees. This method makes the actual cut twice the width of the rail and distributes the cut and weld over a greater area than a cut made at right angles to the rail.

Reinforcements can be made with flat, channel, or angle stock. Because of difficulties encountered when inserting channel reinforcements into frame side rails, the use of angle reinforcements is recommended. Wherever possible, the reinforcement should extend the entire length of the side rail or at least 18" (457,2 mm) beyond the cab cross member. This procedure, of course, is impractical in many instances because of the position of attached units and existing cross members. Reinforcement stock thickness should not exceed that of the side rail to be reinforced.

Wherever possible the parts should be securely riveted together. Hot rivets are recommended, as they can be properly driven with hand tools. Cold rivets are not recommended unless heavy power press equipment to obtain secure fastening is available.

The electric arc-welding method is recommended for all frame welding. Heat of the weld is localized and the burning of material is minimized when this method is used.

In addition to welding thoroughly the cut in the side rail, the outside edges of reinforcements should be welded to the frame after riveting. All unused holes should also be filled with welding material. The welding rod should be of substantially the same material as that used in the frame.

The diameter of the reinforcement rivets depends upon the spacing and the number of rivets used. Generally, rivets are 50% to 100% thicker than the plates to be riveted.

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SUPPLEMENT

"M" SERIES

TRUCK SHOP MANUAL

THE INFORMATION ON THE FOLLOWING PAGES COVERS MODELS STARTING WITH TRUCK SERIAL NUMBERS:

M5-4686
M15-1231
M15A-6401
M16-2525

PREPARED BY
THE GENERAL SERVICE DEPARTMENT
THE STUDEBAKER CORPORATION
SOUTH BEND 27, INDIANA

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DIRECTIONS FOR FILING

• The new "M" Series Truck Shop Manual Supplement, the Preparing for Delivery pages, the Lubrication Chart, the Lubrication Information page, and the new Index, should be filed in the following manner:

1. Remove from the "M" Series Shop Manual and destroy pages 89 to 94 inclusive.
2. Insert the new revised pages as numbered, following page 88, in place of those pages removed.
3. Remove from the Shop Manual and destroy pages 97 to 104 inclusive.
4. Insert the new "M" Series Supplement and the Index pages in the Shop Manual as numbered, immediately following page 96.

THE COUPE EXPRESS, STANDARD, AND HEAVY DUTY MODELS REFERRED TO IN THE SHOP MANUAL ARE DESIGNATED IN THIS SUPPLEMENT BY THEIR MODEL SYMBOLS: *M5, M15 OR M15A, AND M16.*

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SPECIFICATION CHANGES

(M15A specifications are the same as given for the M15 model except as designated.)

ENGINE	M5	M15	M15A	M16
Piston Material	(From truck ser. M5-4686 through truck ser. M5-5000) Ferric-alloy "Parco-Lubrized" (After truck ser. M5-5000) Bearing-Metal-Plated Aluminum-alloy	(From truck ser. M15-1231 through truck ser. M15-2000) Ferric-alloy "Parco-Lubrized" (After truck ser. M15-2000) Bearing-Metal-Plated Aluminum-alloy	Bearing-Metal-Plated Aluminum-alloy	(From truck ser. M16-2525 through truck ser. M16-5200) Ferric-alloy "Parco-Lubrized" (After truck ser. M16-5200) Bearing-Metal-Plated Aluminum-alloy
Piston Clearance	(Ferric-alloy-type) See text, page 101 (Aluminum-alloy-type) See text, pages 4 & 14	(Ferric-alloy-type) See text, page 101 (Aluminum-alloy-type) See text, pages 4 & 14	See text, page 101	(Ferric-alloy-type) See text, page 101 (Aluminum-alloy-type) See text, pages 4 & 14
Piston Pin Clearance	(Ferric-alloy-type) .0004" (0,010 mm) (Aluminum-alloy-type) .0001" to .0003" (0,0025 mm to 0,0076 mm)	(Ferric-alloy-type) .0004" (0,010 mm) (Aluminum-alloy-type) .0001" to .0003" (0,0025 mm to 0,0076 mm)	.0001" to .0003" (0,0025 mm to 0,0076 mm)	(Ferric-alloy-type) .0004" (0,010 mm) (Aluminum-alloy-type) .0001" to .0003" (0,0025 mm to 0,0076 mm)
Oil Filter Type	Fram F4 (After truck ser. M5-5000)	Fram F4 (After truck ser. M15-2000)	Fram F4	Fram F4 (Fram F35 Optional) (After truck ser. M16-5200)
Vibration Damper Type	Rubber	Rubber	Rubber	
GASOLINE				
Carburetor Air Cleaner Type	Wet type (oil bath) (After truck ser. M5-5000)	Wet type (oil bath) (After truck ser. M15-2000)	Wet type (oil bath)	Wet type (oil bath) (After truck ser. M16-5200)
Carburetor	Carter Model — WE 532 S (After truck ser. M5-5000)		Carter Model — WE 532 S	
Carburetor Size	1-1/4" (31,75 mm)		1-1/4" (31,75 mm)	
ELECTRICAL				
Distributor Cam Angle	38°	38°	38°	38°
Spark Plug Model				J-9
Spark Plug Size				14 mm
Battery Number	SW-1-90 (15 plate) (After truck ser. M5-5000)	SW-1-90 (15 plate) (After truck ser. M15-2000)	SW-1-90 (15 plate)	SW-1-90 (15 plate) (After truck ser. M16-5200)
Battery Make	Willard	Willard	Willard	Willard
UNIVERSAL JOINTS				
Lubrication	Lubrication fittings in crosses (After truck ser. M5-5113)			

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SPECIFICATION CHANGES (Continued)

REAR AXLE	M5	M15	M15A	M16
Ratio	4.82 Std.	6.66 (From truck ser. M15-2001 to truck ser. M15-6401)	5.66 Std. } on 120" 6.66 Opt. } W. Base 6.66 Std. } on 128" 5.66 Opt. } W. Base	5.66 or 6.66 *
Two-Speed Vacuum Shift (Optional Equipment)				See text, page 115
Ratio				6.03 and 8.00 * (After truck ser. M16-5200)
Lubrication of Axle Shaft Bearings	Pipe plugs in housing (After truck ser. M5-5000)			
SPRINGS				
Specifications	See text, page 125	See text, page 125	See text, page 125	See text, page 125
SHOCK ABSORBERS				
Make			Delco	
Type			Double-acting (*Std. on 120" W. B.*)	
BRAKES				
Disc-Type Parking Brake (Optional Equipment)				See text, page 126 (After truck ser. M16-5200)
Vacuum Brake Booster (Optional Equipment)				Bendix Model R60-6 See text, page 127
TIRES				
Size	See text, page 129	See text, page 129	See text, page 129	See text, page 129
Casing, Type	Synthetic rubber (After truck ser. M5-5000)	Synthetic rubber (After truck ser. M15-2000)	Synthetic rubber	Synthetic rubber (After truck ser. M16-5200)
Tube, Type	Synthetic rubber (After truck ser. M5-5000)	Synthetic rubber (After truck ser. M15-2000)	Synthetic rubber	Synthetic rubber (After truck ser. M16-5200)

* *Requires Engine Governor* (Not required for 5.66 to 1)

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ENGINE

REAR MAIN BEARING

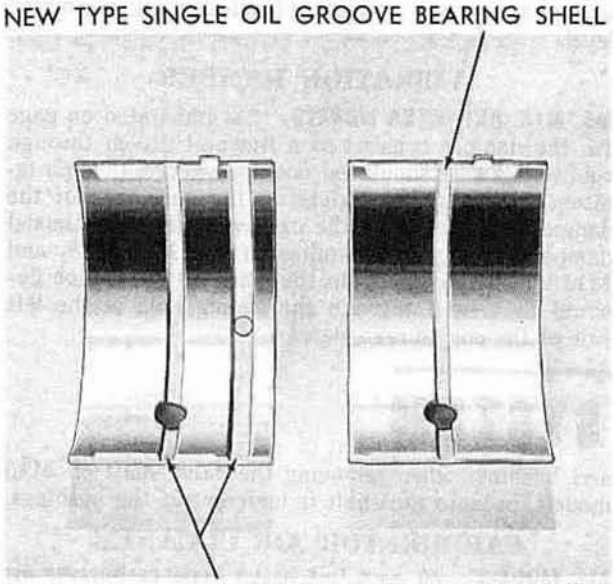

Fig. 1

M16 MODEL The rear main bearing shell has only one oil groove instead of two as used in M16 models of earlier production. The elimination of the rearward groove provides increased bearing area. The rear main bearing shell shown on the left in figure 1 is that used in former models; the new type single groove bearing shell is shown on the right. The single groove bearing can be used in M16 models of earlier production.

PISTONS — FERRIC-ALLOY

GENERAL—M5, M15, AND M16 MODELS Cam ground ferric-alloy pistons are used in the engines of all trucks between the following truck serial numbers: M5, from M5-4685 to M5-5001; M15, from M15-1230 to M15-2001; M16, from M16-2524 to M16-5201.

The pistons are "Parco-Lubrized" (a finish coating process) to promote rapid break-in. The coating acts as a polishing agent and retains oil; thus, piston scuffing and cylinder wall scoring are minimized.

Before installation in the cylinder, the piston and ring assembly should be submerged in a clean oil bath. Pistons marked with a pattern number, located on the piston inside surface below and near one of the two pin bosses, should be installed in the cylinder with the pattern number toward the front of the engine. Pistons not having a pattern number, but marked instead, with a raised boss inside the piston skirt and level with the piston pin holes, should be installed in the cylinder with the boss toward the camshaft side of the engine.

PISTON PIN BUSHINGS—M5, M15, AND M16 MODELS Ferric-alloy pistons are fitted with pin bushings which are pressed into place. The oil holes in the bushings line up with corresponding holes in the piston bosses, and the oil groove in each bushing is installed toward the top of each piston. (See figure 2.)

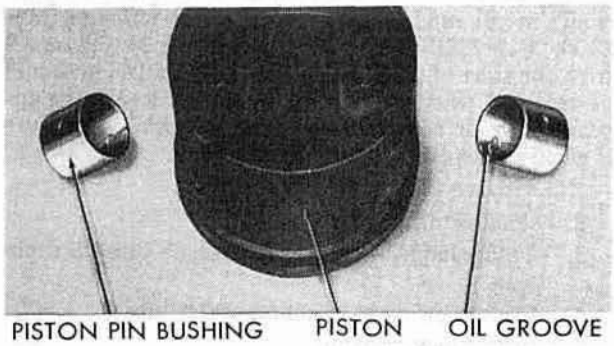

Fig. 2

PISTON PINS—M5, M15, AND M16 MODELS Piston pins used with ferric-alloy pistons should be fitted to a clearance of .0004" (0,0101 mm). Correct fitting is obtained by first selecting a pin which gives a wringing fit at room temperature of about 70° F. (21° C.). A pin having a diameter .0004" (0,0101 mm) less than the one giving the wringing fit should be used with the piston. Pistons in service stock are fitted with pins and bushings.

PISTON FITTING—M5, M15, AND M16 MODELS Although piston fitting procedure is unchanged from the detailed steps outlined on page 14, the spring scale pull with ferric-alloy pistons should be from 15 to 20 pounds (6,8 to 9,07 kgs) using 1" (25,4 mm) wide feeler stock of .002" (0,0508 mm) thickness.

PISTON RINGS — M5 AND M15 MODELS Minor changes have been made in the section design of the compression rings used with ferric-alloy pistons. Since the alterations cannot readily be detected with the eye, it is important that the rings be referred to by part number in every case. The new compression rings are of the uniform-pressure type, exerting equal cylinder wall pressure around the entire ring surface and at the gap.

Uncoated cast-iron oil control rings are used. The ring chamfer has been altered to improve oil control and to equalize oil distribution around the ring. All piston ring specifications are identical to those given in the Engine Specifications section of this manual, page 4. Of course, the installation procedure remains unchanged.

PISTON RINGS—M16 MODEL The oil control ring has been redesigned for use with ferric-alloy pistons insofar as to extend the oil slot to the gap ends. The ring specifications are as given on page 4. Although the new ring can be identified from the one used previously, the new oil control ring should be referred to by part number.

PISTONS — ALUMINUM-ALLOY

GENERAL — ALL MODELS Bearing-metal-plated aluminum-alloy pistons are used in the engines of all models after the following truck serial numbers: M5-5000; M15-2000; M16-5200; and in the engines of M15A models from the start of production. The related specifications on page 4, and the piston fitting instructions on page 14, apply to all models.

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OIL FILTER

ALL MODELS A Fram F4 oil filter is standard equipment on all models after truck serial numbers M5-5000, M15-2000, M16-5200, and on the M15A model from the start of production. The filter cartridge should be replaced whenever the oil on the oil level gage appears dirty or contaminated. The following procedure is given for replacing the filter cartridge:

1. Remove cover.
2. Remove drain plug.
3. Drain sludge — remove cartridge — install drain plug.
4. Install new cork gasket on center tube.
5. Install new cartridge.
6. Install new cork gasket on center tube.
7. Install new cover gasket on cover.
8. Reinstall cover.

After replacing cartridge, run engine for ten minutes; check filter and lines for leaks, and check oil level.

VIBRATION DAMPER

M5, M15, AND M15A MODELS As illustrated on page 16, the damper consists of a flywheel driven through rubber discs. It should be noted, however, that no ignition timing marks appear on the outer rim of the damper flywheel as is the case with the M16 model damper. The ignition timing on the M5, M15, and M15A models is set from the mark on the engine flywheel as viewed through the timing hole in the left side of the engine rear plate.

GASOLINE SYSTEM

MANIFOLD

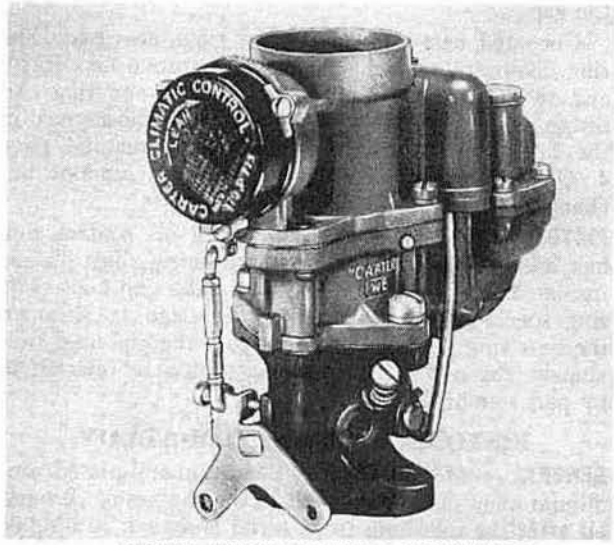
ALL MODELS To minimize the possibility of the heater valve shaft sticking, stainless-steel bushings have been provided in the manifold. The procedure followed in servicing the manifold heater valve assembly is the same as outlined on page 23, except on the M16 model. It is necessary to remove the heater valve and bushings when removing the valve shaft on M16 models, because the shaft is undercut at the bushings.

CARBURETOR AIR CLEANER

ALL MODELS A wet (oil bath) type carburetor air cleaner is standard equipment on all models after the following truck serial numbers: M5-5000; M15-2000; M16-5200; and on the M15A from the start of production. For servicing instructions, refer to page 23.

CARBURETOR

GENERAL—M5 AND M15A MODELS The carburetor used on the M5 model after truck serial number M5-5000, and on the M15A model from the start of production, is a Carter Model WE 532 S. The fast idle cam in this carburetor is enclosed in the climatic control. A baffle plate and gasket separate the climatic control housing and thermostatic coil from the choke linkage and serve to circulate the heated air thoroughly through the coil area. A climatic control air strainer (screen) is not used in this model carburetor. The idle by-pass air bleed is located above the choke valve, to provide quicker starting with a cold engine.



CARTER MODEL WE 532 S CARBURETOR

Fig. 3

DISASSEMBLY—MODEL WE 532 S

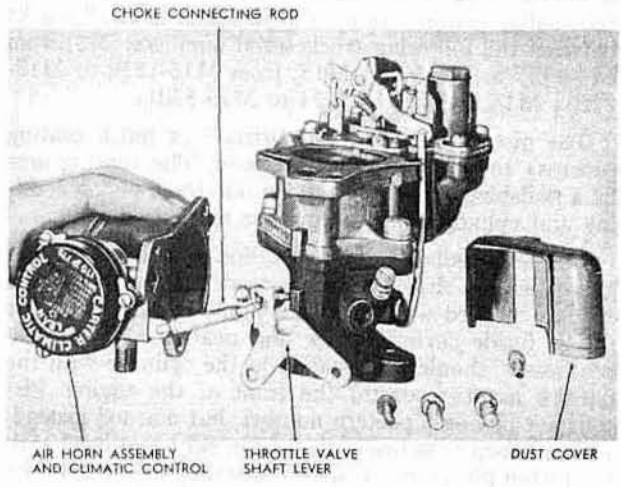


Fig. 4

Remove the dust cover, and the air horn assembly, tilting the latter during removal so that the choke connecting rod can be removed from the throttle valve shaft lever.

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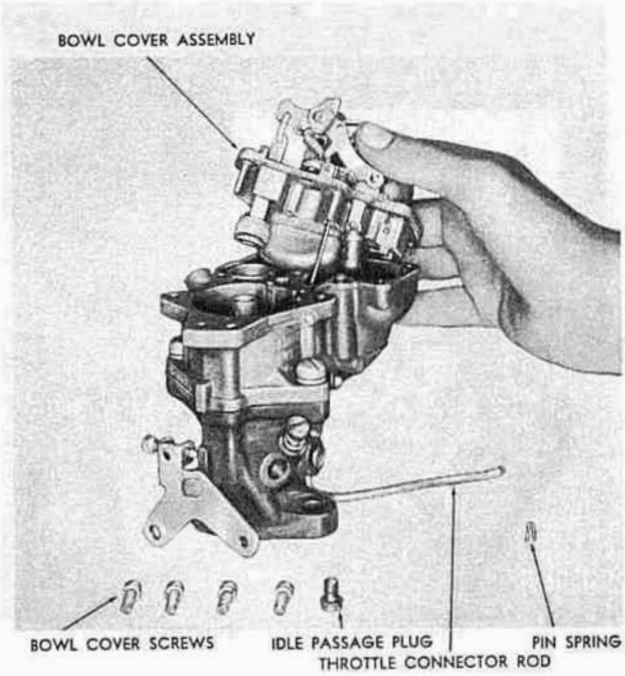

Fig. 5

Disconnect the throttle connector rod by removing the pin spring at the upper end of the rod. Take out the four bowl cover screws and the idle passage screw plug. Remove the bowl cover assembly.

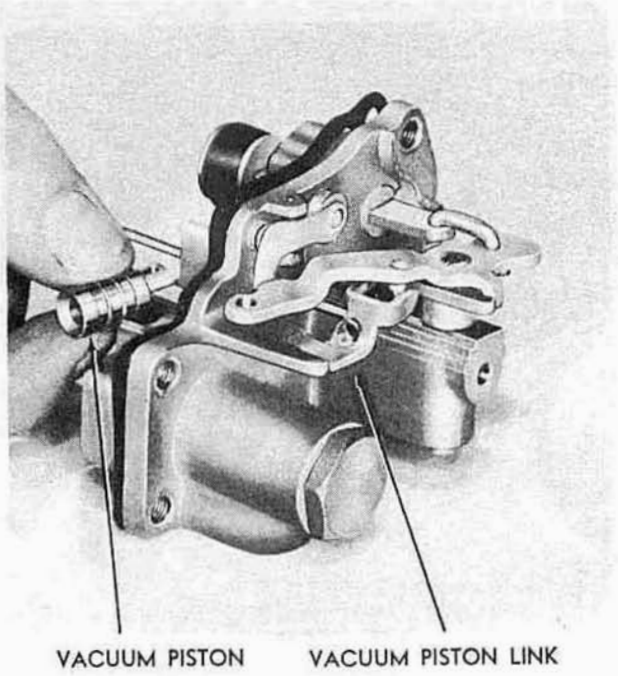

Fig. 6

To disassemble the bowl cover assembly, first unhook the vacuum piston from the vacuum piston link.

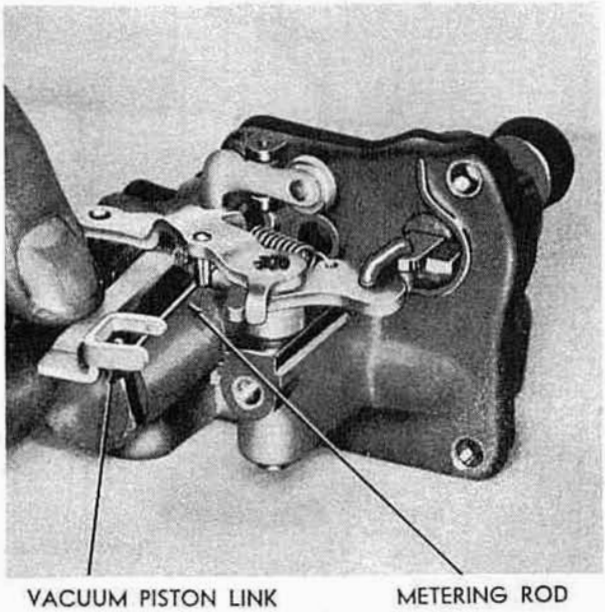

Fig. 7

The vacuum piston link and metering rod spring, and the metering rod and disk may then be removed from the bowl cover.

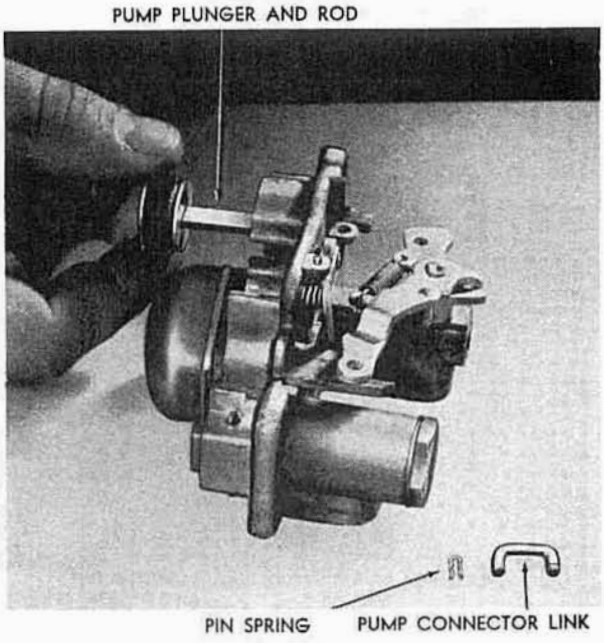

Fig. 8

Remove the pin spring and pump connector link. Then remove the accelerating pump plunger and rod assembly.

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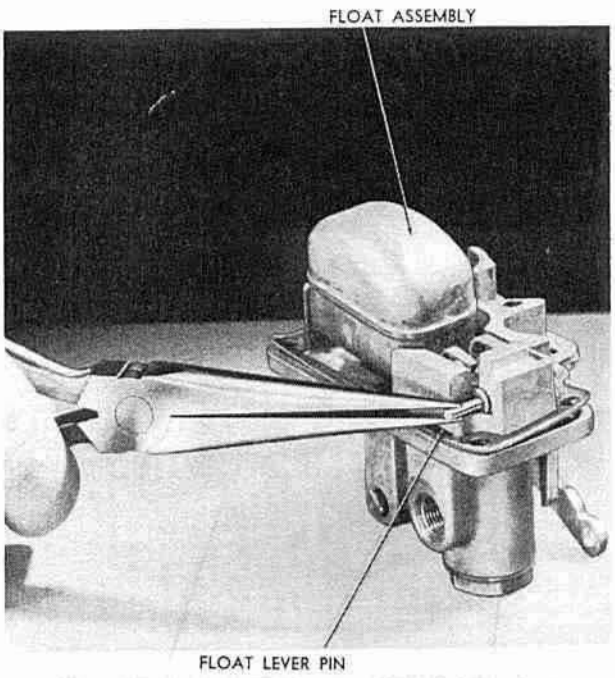

Fig. 9

After the float lever pin is removed, then the float and lever assembly and the float needle can be removed.

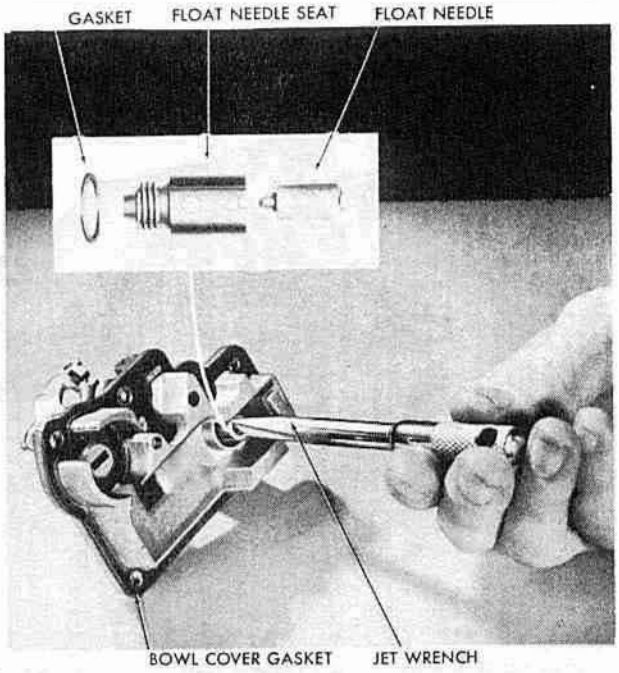

Fig. 10

Remove the float needle seat, using jet wrench No. J-816-6; then remove the fuel bowl strainer nut and gasket, and the strainer, from the top of bowl cover. Remove the bowl cover gasket.

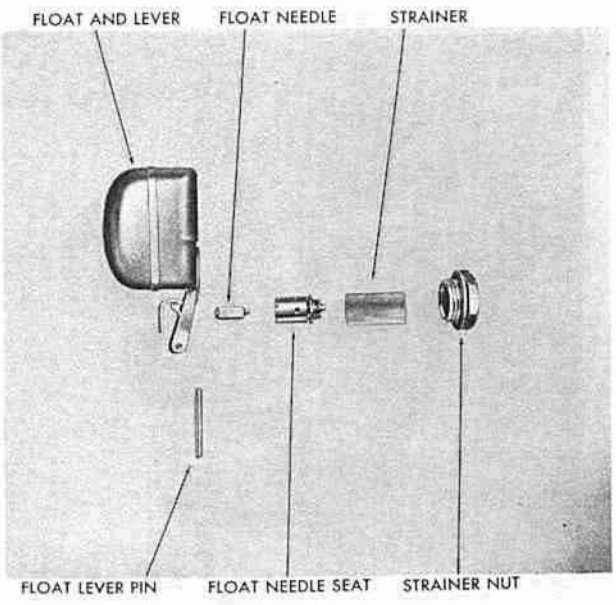

Fig. 11

Figure 11 shows the parts of the float circuit in their sequence of assembly.

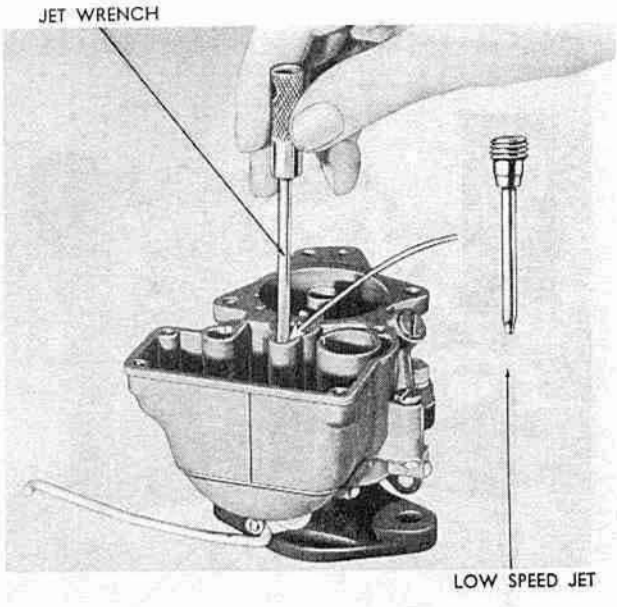

Fig. 12

Remove the low speed jet, using jet wrench No. J-816-1. Clean and inspect the low speed jet and seat for possible damage.

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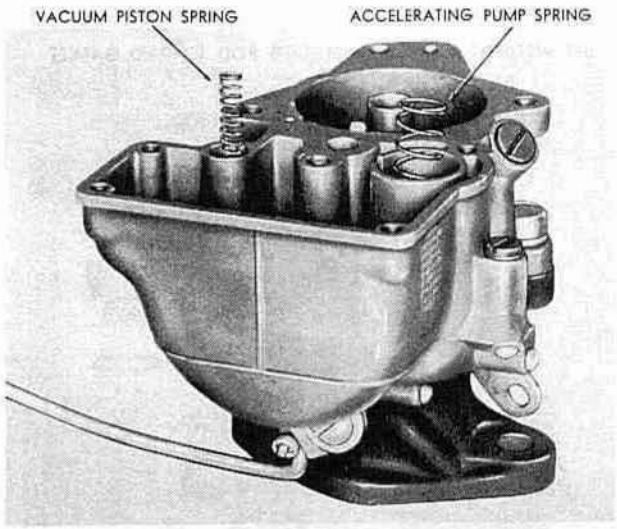

Fig. 13

Remove the accelerating pump spring and the vacuum piston spring.

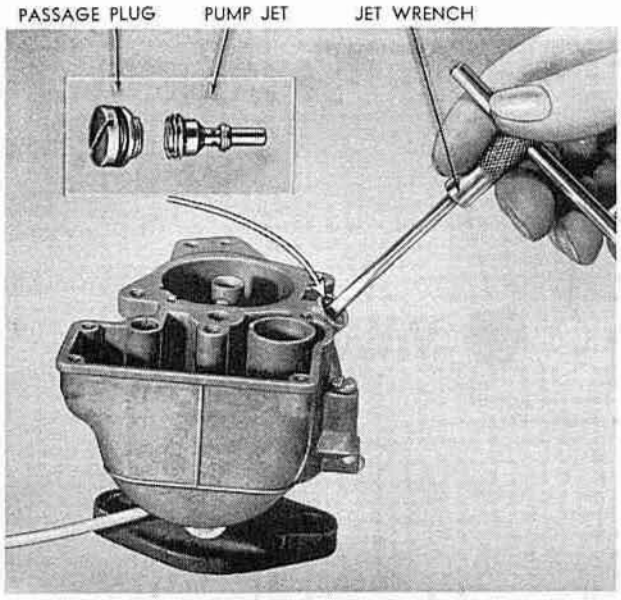

Fig. 14

Remove the pump discharge jet passage plug and gasket, using jet wrench No. J-816-6. Then remove the pump jet, using jet wrench No. J-816-2. Inspect the pump jet and seating surfaces for damage; also inspect the passages.

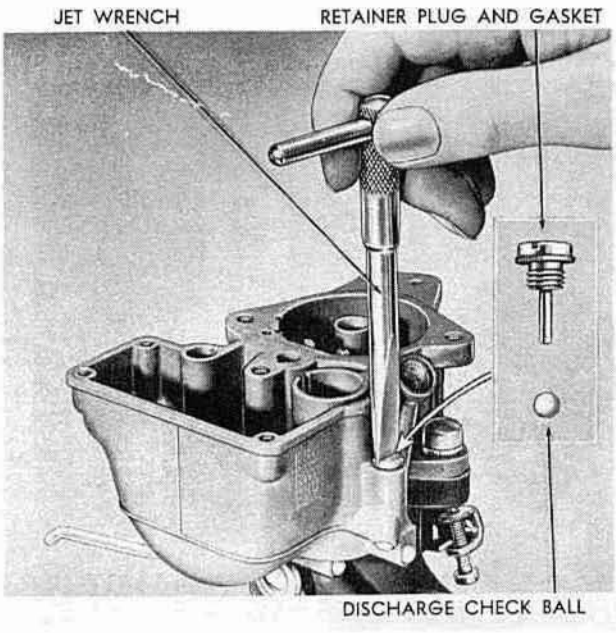

Fig. 15

Remove the pump discharge check ball retainer screw plug and gasket, using jet wrench No. J-816-6, and the pump check ball.

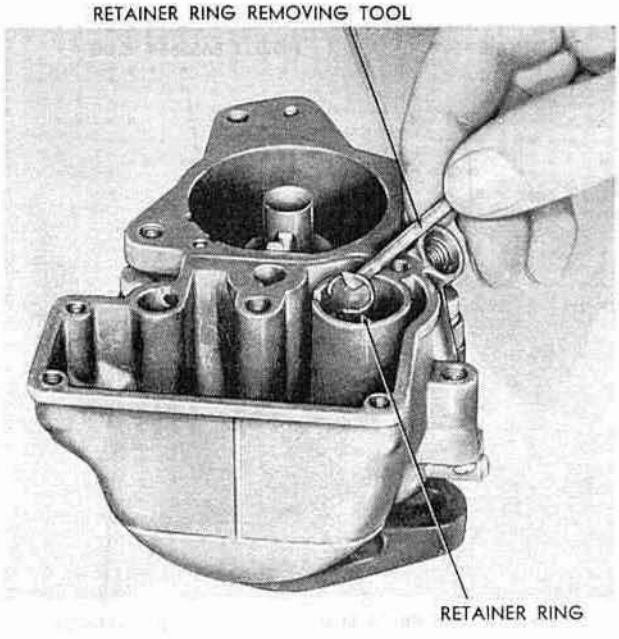

Fig. 16

Turn the carburetor body up-side-down to remove the accelerating pump strainer. Use retainer ring removing tool No. T109-56 to remove the accelerating pump inlet check ball retainer ring; turn carburetor body up-side-down again to remove the accelerating pump inlet check ball. (When installing the ball retainer ring, use retainer ring installing tool No. J-1407.)

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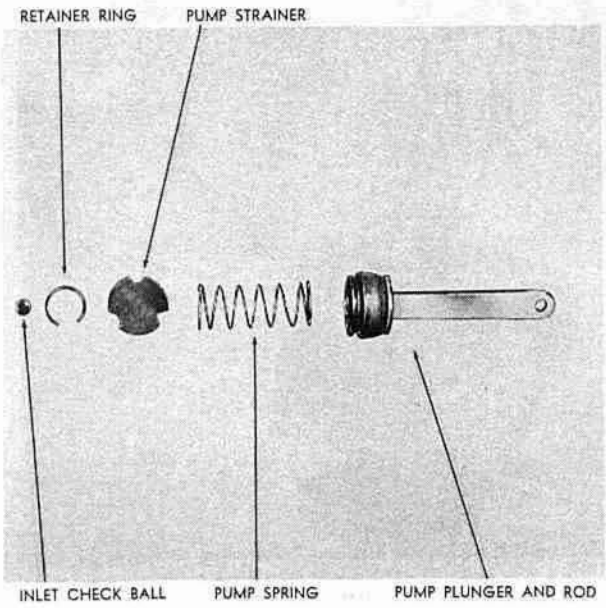

Fig. 17

Figure 17 shows the accelerating pump plunger assembly and related parts.

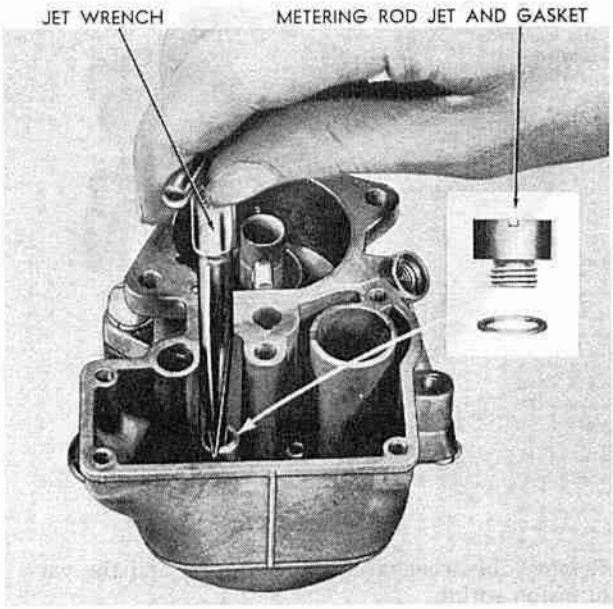

Fig. 18

Remove the metering rod jet and gasket, using jet wrench No. J-816-6.

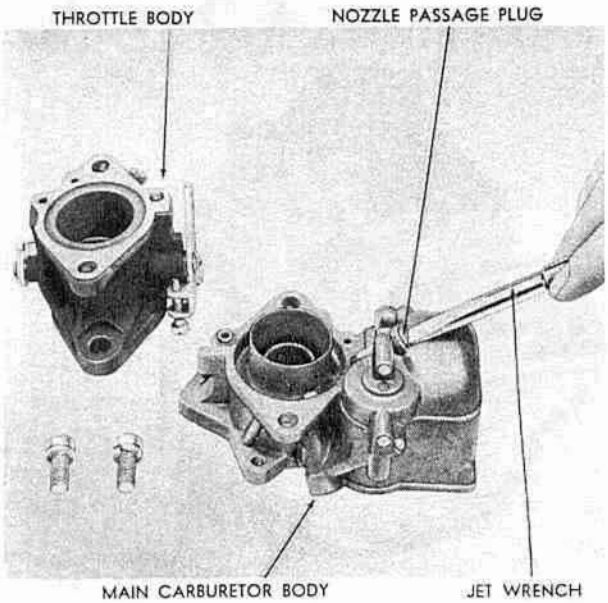

Fig. 19

By taking out two screws, the main carburetor body can be removed from the throttle body. Then remove the main discharge nozzle passage plug, using jet wrench No. J-816-6.

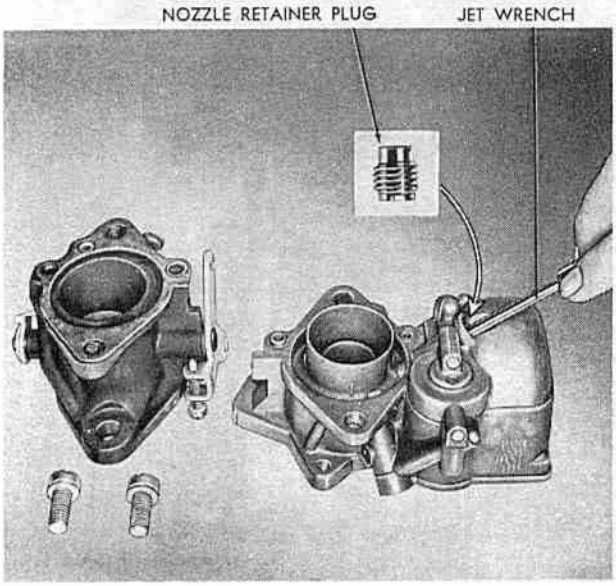

Fig. 20

Remove the main discharge nozzle retainer plug, using jet wrench No. J-816-2.

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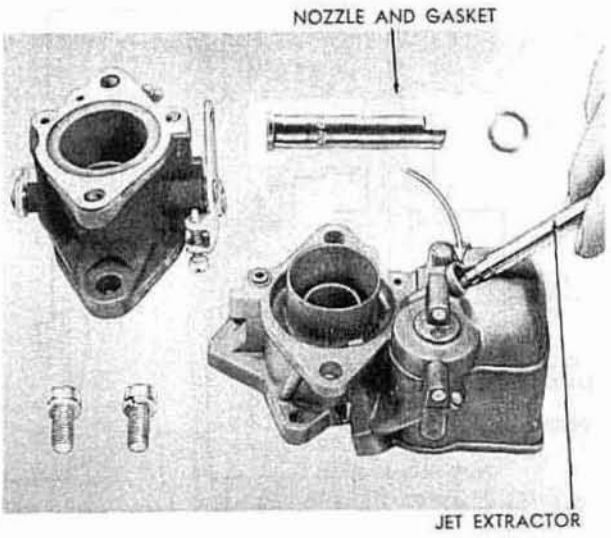

Fig. 21

Remove the main discharge nozzle, using jet extractor No. J-508. Be sure to remove the small copper gasket which fits around the seat of the main discharge nozzle. Clean and inspect the nozzle; replace it if the inspection shows the nozzle is damaged.

Fig. 22

Remove the idle adjustment screw and the idle port rivet plug, using rivet extractor No. T109-42.

CLEANING AND REASSEMBLING—MODEL WE 532S All carburetor parts and passages should be cleaned thoroughly with Bendix Cleaner (No. 1328), rinsed with solvent, and blown out with compressed air before reassembling the carburetor. Inspect all parts for wear or damage and replace if necessary. Do not oil the linkage or any internal parts of the carburetor. Use No. 3 graphite grease on pump countershaft. Reassemble the carburetor by reversing the disassembly procedure. Replace all gaskets with new ones when reassembling. Replace the accelerating pump plunger assembly if the leather shows wear or mutilation.

ADJUSTMENTS—MODEL WE 532S

Figure 23 shows the various parts that make up the float circuit. Gasoline enters the fuel bowl through the fuel bowl strainer and through the needle valve. The needle valve is controlled by the float and the height of the fuel level in the fuel bowl.

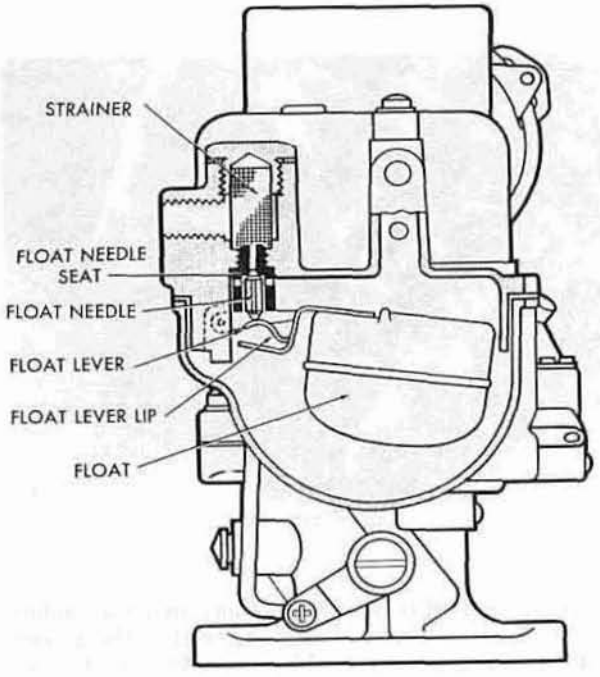

Fig. 23

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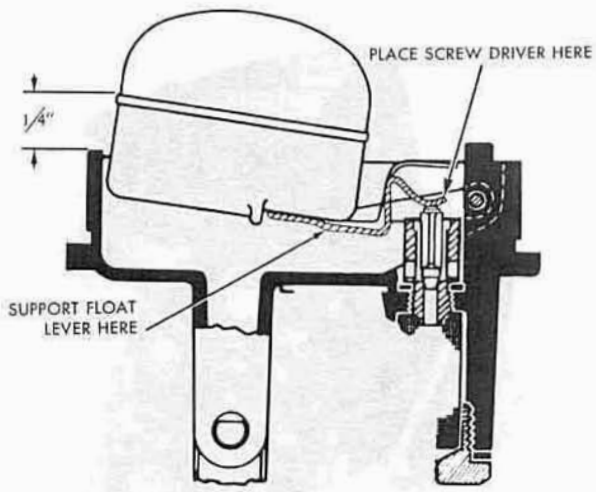

Fig. 24

The float maintains the proper level of the fuel in the bowl of the carburetor. To check the float level, turn the bowl cover up-side-down, allowing the weight of the float to be supported by the float arm lip resting on the needle valve. There should be 1/4" (6,35 mm) between the boss on the bowl cover and the far edge of the float seam. Use float gage No. J-818-6 in checking the float level.

If an adjustment is necessary, support the float by placing a finger under the float lever; then, by exerting a slight pressure with a screwdriver against the *tip* of the float lever lip, bend the lip as necessary to raise or lower the float level.

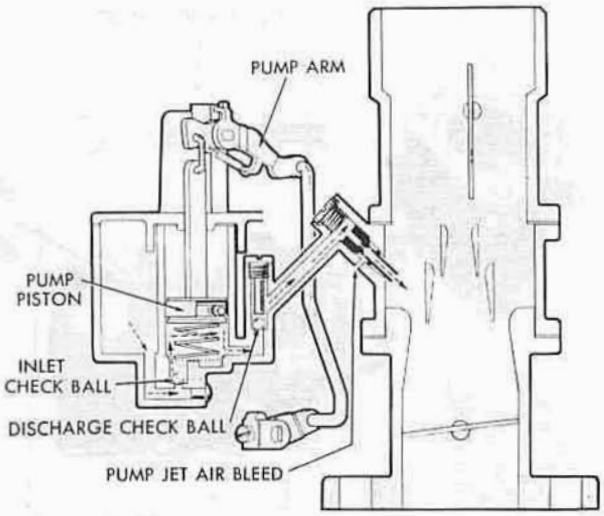

Fig. 25

The arrows in figure 25 indicate the passage of fuel through the accelerating pump circuit.

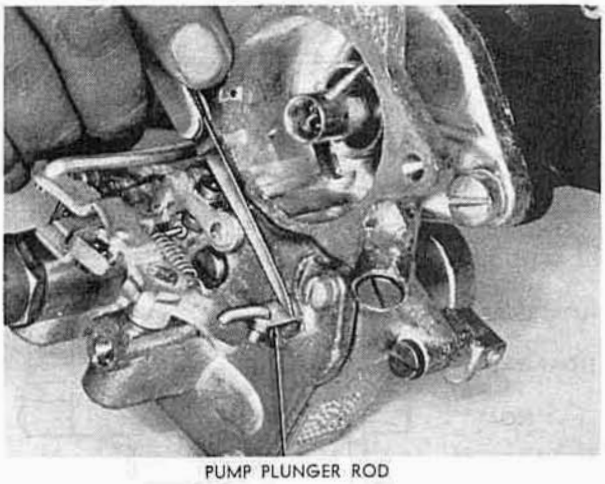

Fig. 26

After the bowl cover assembly has been reassembled to the main carburetor body, the travel of the accelerating pump plunger should be checked as follows: back off the throttle lever adjusting screw to permit a fully closed throttle position; set the throttle at wide open position, and mark the pump plunger rod at the level of the boss on the bowl cover.

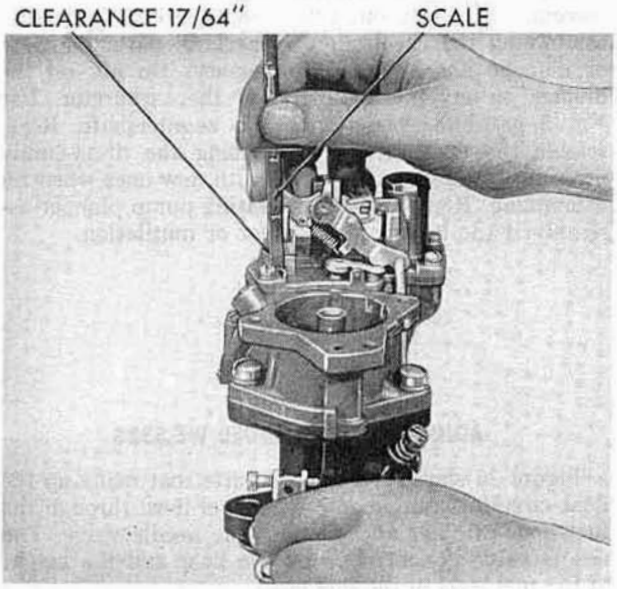

Fig. 27

Then close the throttle and measure with a scale the height of the mark on the pump plunger rod above the bowl cover boss. This distance should be 17/64" (6,747 mm).

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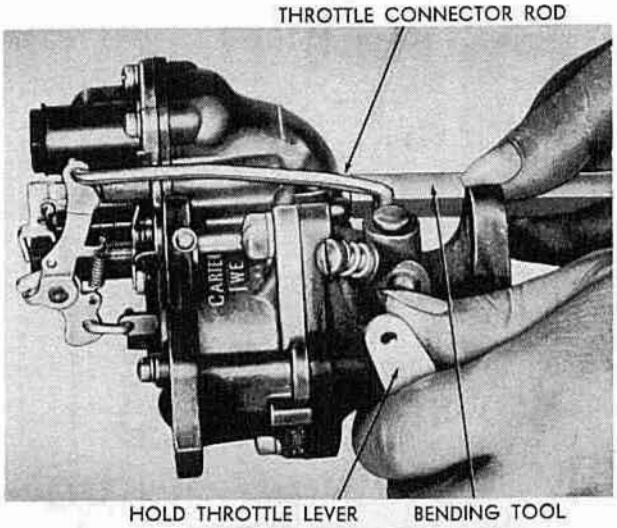

Fig. 28

If the height of the mark on the pump plunger rod is not correct, it should be adjusted by bending the throttle connector rod with bending tool No. J-1137 at the point shown in figure 28.

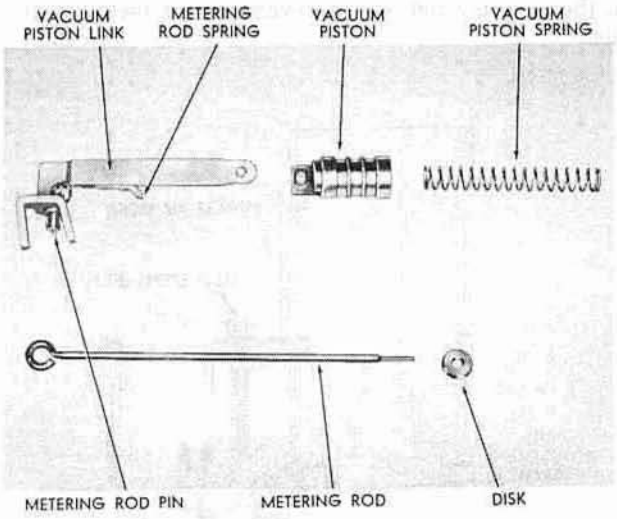

Fig. 30

Figure 30 shows parts of the vacuum piston link and metering rod assembly.

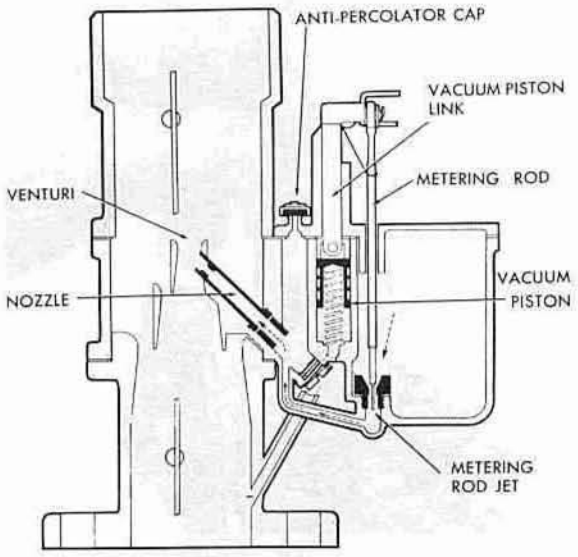

Fig. 29

The arrows in figure 29 indicate the passage of fuel through the high speed circuit.

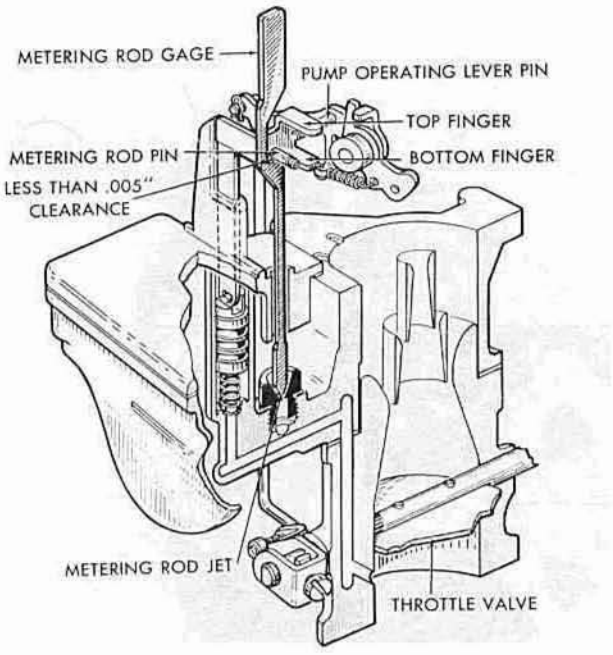

Fig. 31

The throttle lever adjusting screw must be backed off to set the metering rod. Insert metering rod gage No. T109-102 in place of the metering rod, seating the tapered end of the gage in the metering rod jet. With the throttle valve closed, press down lightly on the vacuum piston link. There should be less than .005" (0,13 mm) clearance between the metering rod pin and the shoulder of the notch in the gage. The gage must not drag on the pin.

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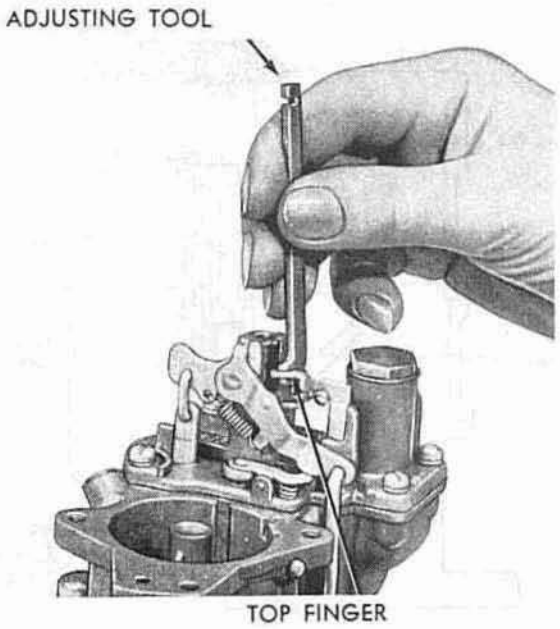

Fig. 32

If adjustment is necessary, it should be made by bending the top finger on the vacuum piston link, using adjusting tool No. J-1389.

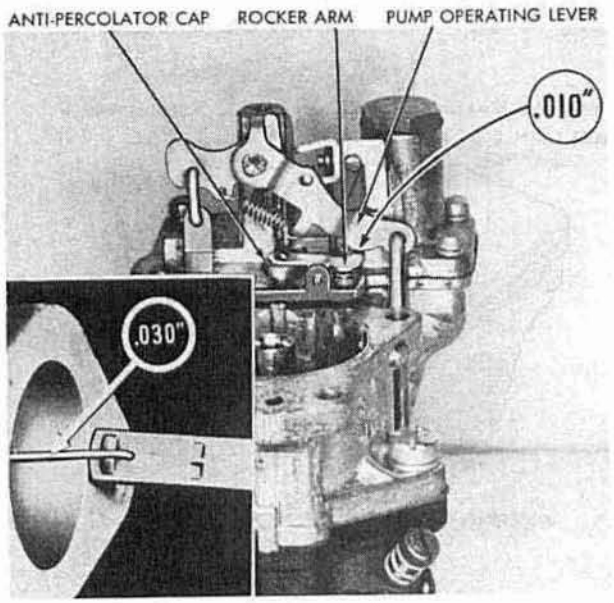

Fig. 34

To check the seating of the anti-percolator cap, insert a .030" (0,76 mm) wire or drill in the throttle body opposite the idle port. With the throttle closed on the wire or drill, there should be .010" (0,25 mm) clearance between the anti-percolator rocker arm and the pump operating lever. If the clearance is not correct, bend the anti-percolator rocker arm to adjust it.

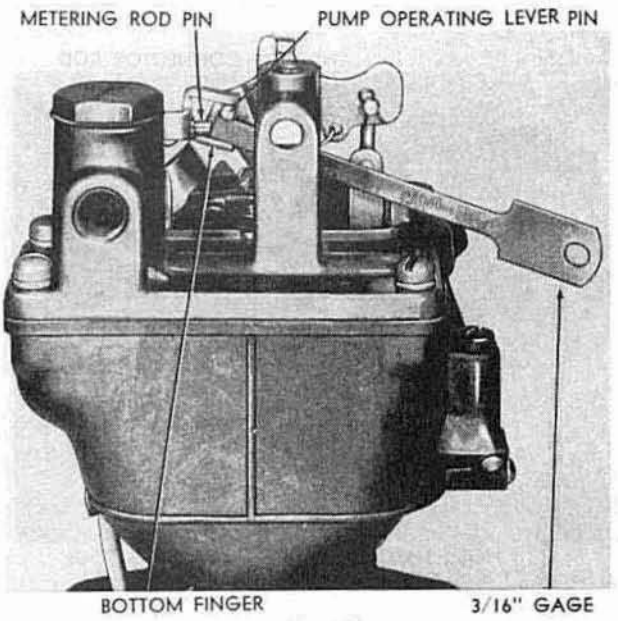

Fig. 33

After adjusting the top finger of the vacuum piston link for metering rod setting, adjust the bottom finger to permit 3/16" (4,763 mm) clearance between the bottom of the pin on the pump operating lever and the bottom finger of the vacuum piston link, using gage No. J-818-3. Install the metering rod and disk, making sure the metering rod spring is hooked around the metering rod. If it is not, the metering rod may move in the metering rod jet to prevent correct metering of fuel.

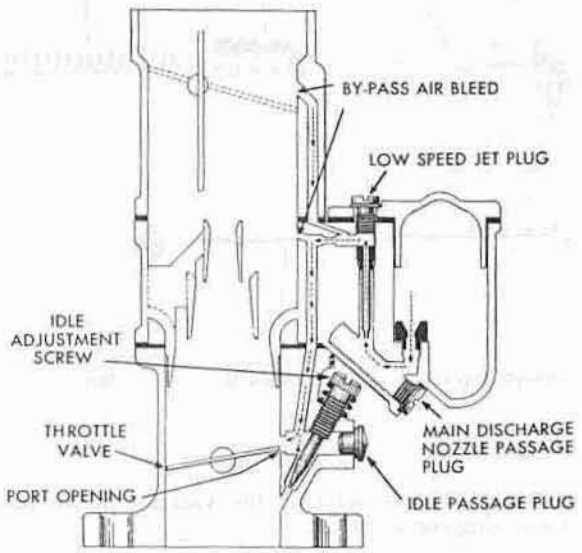

Fig. 35

The arrows in figure 35 indicate the direction of the flow of fuel through the parts and passages of the low speed circuit.

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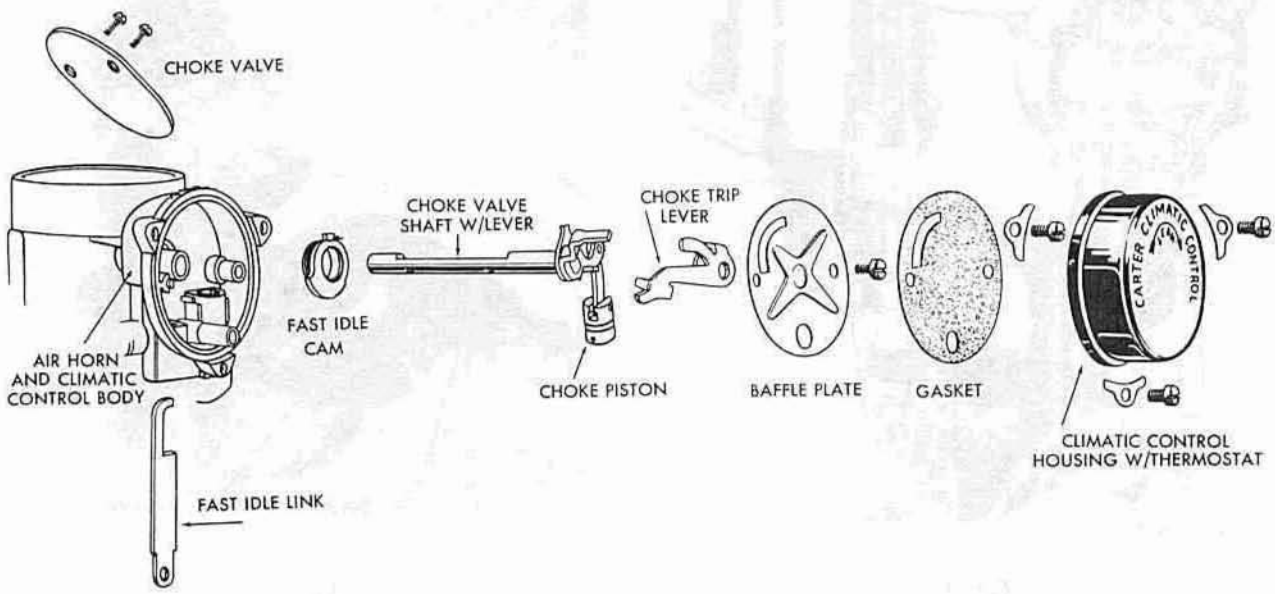

Fig. 36

Figure 36 shows the parts of the climatic control in the order of their assembly.

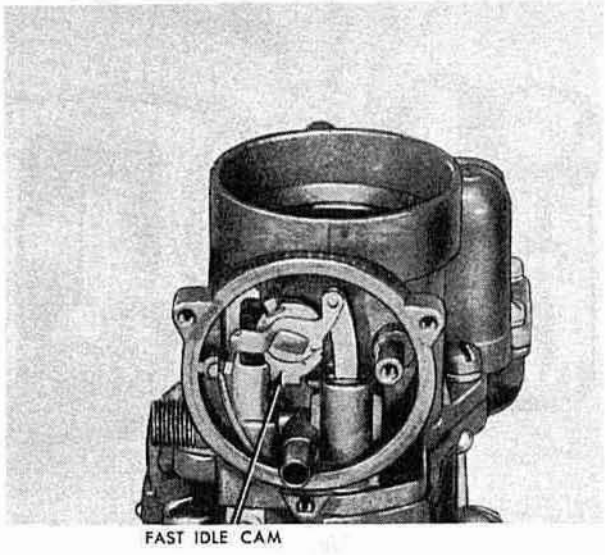

Fig. 37

Figure 37 shows the position of the fast idle cam with the choke valve closed.

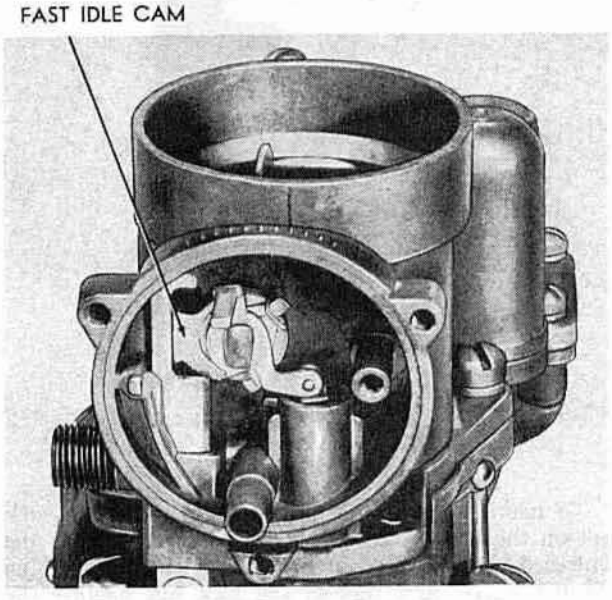

Fig. 38

Figure 38 shows the position of the fast idle cam with the choke valve open.

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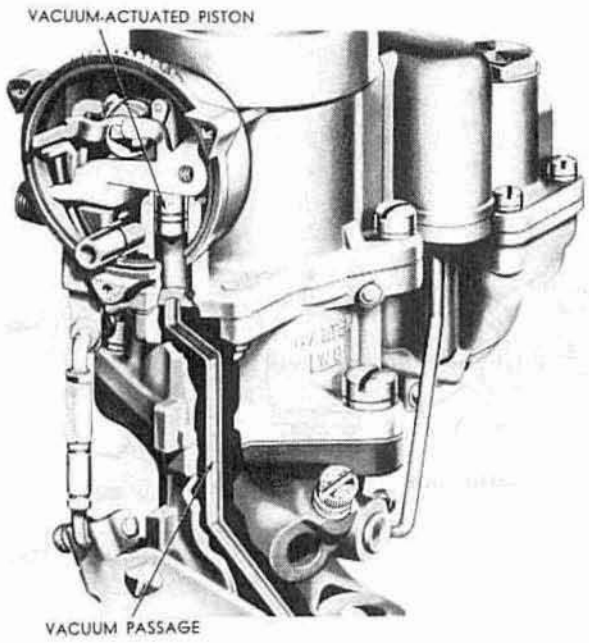

Fig. 39

Figure 39 illustrates the choke mechanism with a cut-away view of the vacuum-actuated piston.

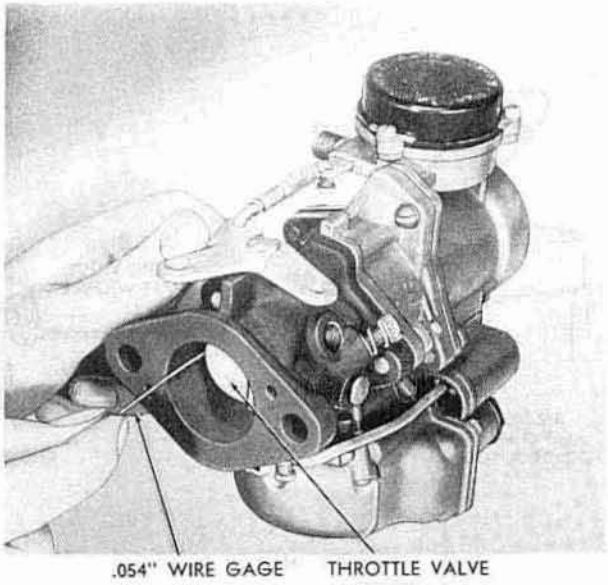

Fig. 40

To check the fast idle, the climatic control housing and thermostat must be in place. Open the throttle wide to make sure the cam drops into position and the choke valve is fully closed; then close the throttle and check the clearance with a .054" (1,37 mm) wire gage, No. T109-188, between the throttle valve and the bore on the side opposite the idle port.

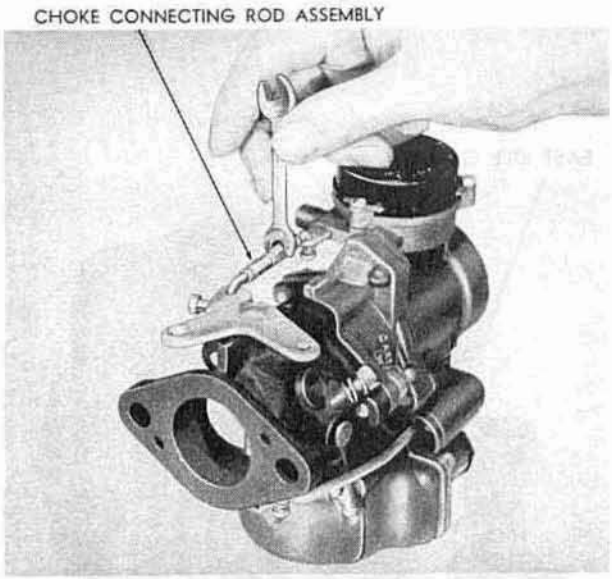

Fig. 41

To make the fast idle adjustment, loosen the lock nut on the choke connecting rod assembly, adjust the threaded sleeve to obtain the correct clearance at the throttle valve, and tighten the lock nut against the sleeve. The sleeve must be held securely while tightening the lock nut, to prevent distortion of the choke linkage. The choke mechanism must not bind in any position.

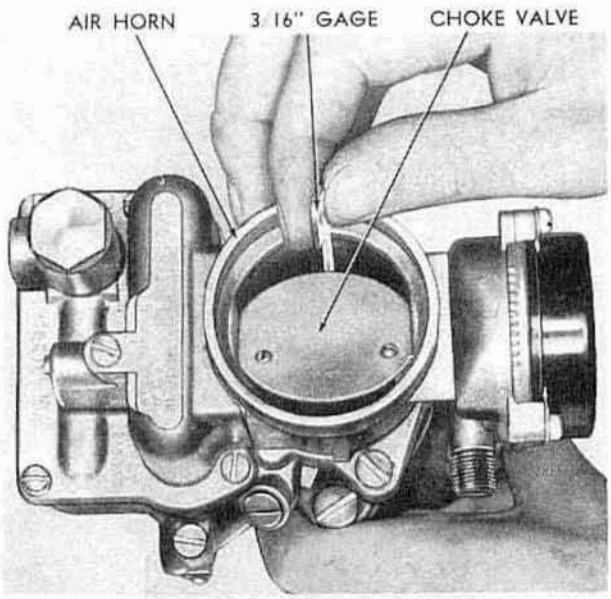

Fig. 42

To check the choke valve opening with wide open throttle, open the throttle wide, and insert 3/16" (4,763 mm) gage No. J-818-3 between the low side of the choke valve and the inside of the air horn.

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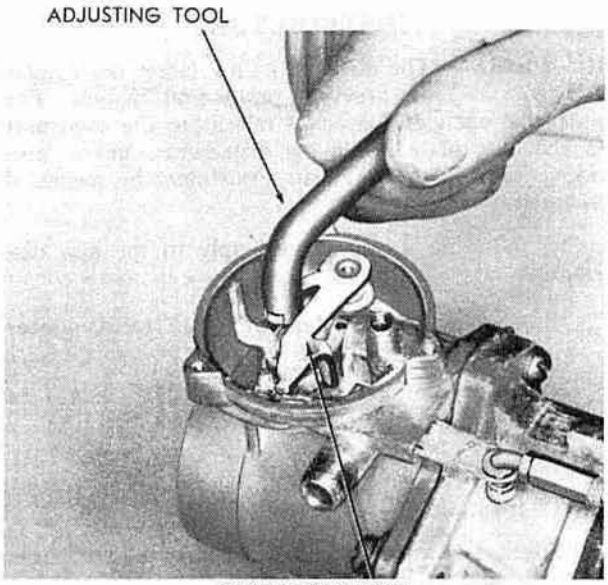

Fig. 43

If it is necessary to make an adjustment, remove the climatic control housing and thermostat, gasket, and baffle plate, and bend the choke trip lever as shown in figure 43, using unloader adjusting tool No. T109-187, until the correct clearance is obtained.

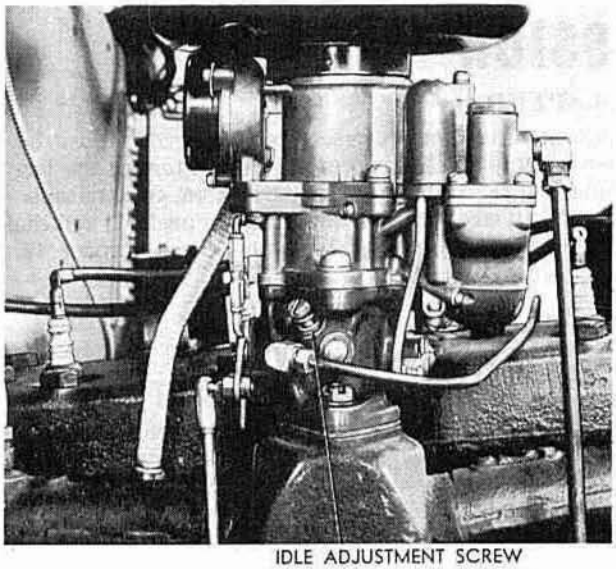

Fig. 45

Adjust the idle mixture by turning the idle adjustment screw clockwise for a leaner mixture, or counterclockwise for a richer mixture. The correct adjustment should be between 1/2 and 1-1/2 turns out. Idle adjustment should be made with the carburetor air cleaner installed, and the engine at normal operating temperature.

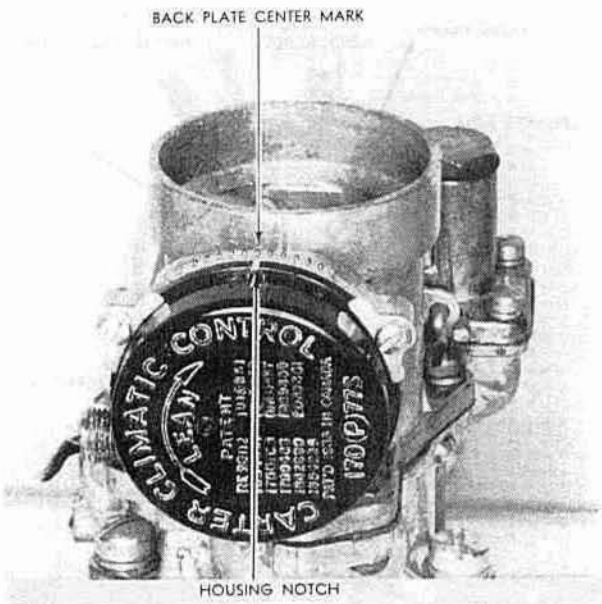

Fig. 44

Before attempting an adjustment of the climatic control, it is important first to check thoroughly all other items that affect the warm-up period. In production, the notch on the climatic control housing and the center mark on the back plate are in line. This setting should be satisfactory for operation under average conditions. However, under extreme weather conditions, or for continuous use of fuels of other than standard octane ratings, the adjustment can be changed by rotating the climatic control housing counter-clockwise for a longer warm-up period, or clockwise for a shorter warm-up period. Do not move the housing more than 1 notch per adjustment.

CARBURETOR TOOLS

The tools listed below are required to service the Carter Model WE 532 S Carburetor.

The tools listed in the *first* column are supplied by the Hinckley-Myers Division, Jackson, Michigan. If it is desired to purchase a complete set of combination Stromberg and Carter carburetor tools, Kit No. J-505-SCT should be ordered from Hinckley-Myers.

The part numbers of the tools listed in the *second* column should be used when the tools are ordered from the Carter Carbureter Corp., St. Louis, Mo. Carter does not market these tools under a complete kit number.

	Hinckley-Myers	Carter
Jet Wrench	J-816-1	T109-59
Jet Wrench	J-816-2	T109-58
Jet Wrench	J-816-6	T109-57
Jet Wrench Handle	J-816-5	T109-51
Retainer Ring Removing Tool	J-1306	T109-56
Retainer Ring Installing Tool	J-1407	T109-122U
Jet Extractor	J-508	T109-55
Rivet Extractor	KMO-481	T109-42
Float Gage	J-818-6	T109-31
Bending Tool	J-1137	T109-41
Metering Rod Gage	J-1265	T109-102
Adjusting Tool	J-1389	T109-105
Float Gage	J-818-3	T109-28
Wire Gage (.054")	KMO-480	T109-188
Unloader Adjusting Tool	KMO-478	T109-187

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ELECTRICAL SYSTEM

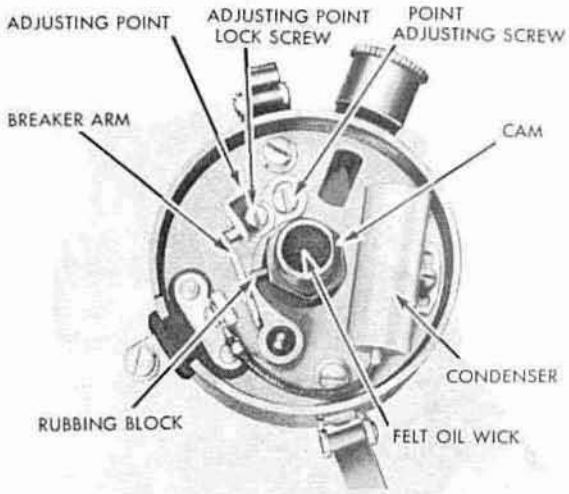

Fig. 46

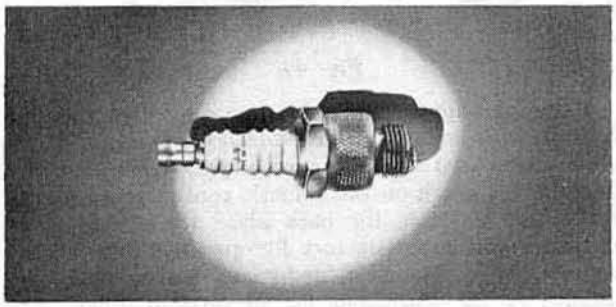

Fig. 47

DISTRIBUTOR

ALL MODELS The distributors are larger but similar to those used on previous production models. The noticeable changes consist of relocating the condenser on the base plate inside the distributor, and in providing for breaker point gap adjustment by means of an eccentric screw.

The following specifications apply to the new distributors:

Breaker arm spring tension — 17 to 20 ounces (482 to 567 grams)

Breaker point gap — .018″ to .022″ (0,457 to 0,56 mm)

Cam angle — 38°

Cam rotation — counter-clockwise

Spark and vacuum advance charts — see pages 36 and 37.

SPARK PLUGS

M16 MODEL Champion J-9 (14 mm) spark plugs are used.

BATTERY

ALL MODELS A 15-plate battery, Willard No. SW-1-90, is used after truck serial numbers M5-5000, M15-2000, M16-5200, and on the M15A model from the start of production.

TRANSMISSION

SHIFT LEVER (4-SPEED)

ALL MODELS The shift lever on the model T9 four-speed transmission used after truck serial numbers M5-5000 (optional equipment), M15-2000, M15A-6400, and M16-5200, does not carry a reverse control latch rod; instead, an internal spring arrangement simplifies shifting into reverse, which is accomplished by moving the lever from neutral position toward the far-right and rearward. With this exception, this transmission is similar to the one illustrated on page 52, and the specifications are the same as those listed on page 47.

CLUTCH

OPERATING SHAFT AND LINKAGE

ALL MODELS A spring-loaded bracket to carry the outer end of the clutch operating shaft is used on all models after truck serial numbers M5-5000, M15-2000, M16-5200, and on the M15A from the start of production. A lubrication fitting at the bracket permits lubrication of the shaft. There is also a brace from the pedal shaft to the frame crossmember.

To adjust the clutch linkage, remove one clevis pin and loosen the lock nut on the clutch operating rod. Adjust the clutch pedal so as to have a minimum of 1″ (25,4 mm) free travel before the resistance of the release mechanism is felt.

UNIVERSAL JOINTS

LUBRICATION

M5 MODEL After truck serial number M5-5113, each universal joint cross is equipped with a lubrication fitting. Lubricate with chassis lubricant at 1,000 mile (1.609 km) intervals, using a low-pressure hand gun or a pressure gun equipped with a pressure control extension coupling (maximum pressure setting not to exceed 1500 to 1600 pounds [1607 to 1714]).

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REAR AXLE

GENERAL — M15 AND M15A MODELS Timken rear axle number 53521 is used on the M15 model between truck serial numbers M15-2000 and M15-6401. Timken rear axle number 53625 is used on all other M15 and all M15A models.

TWO-SPEED VACUUM SHIFT REAR AXLE

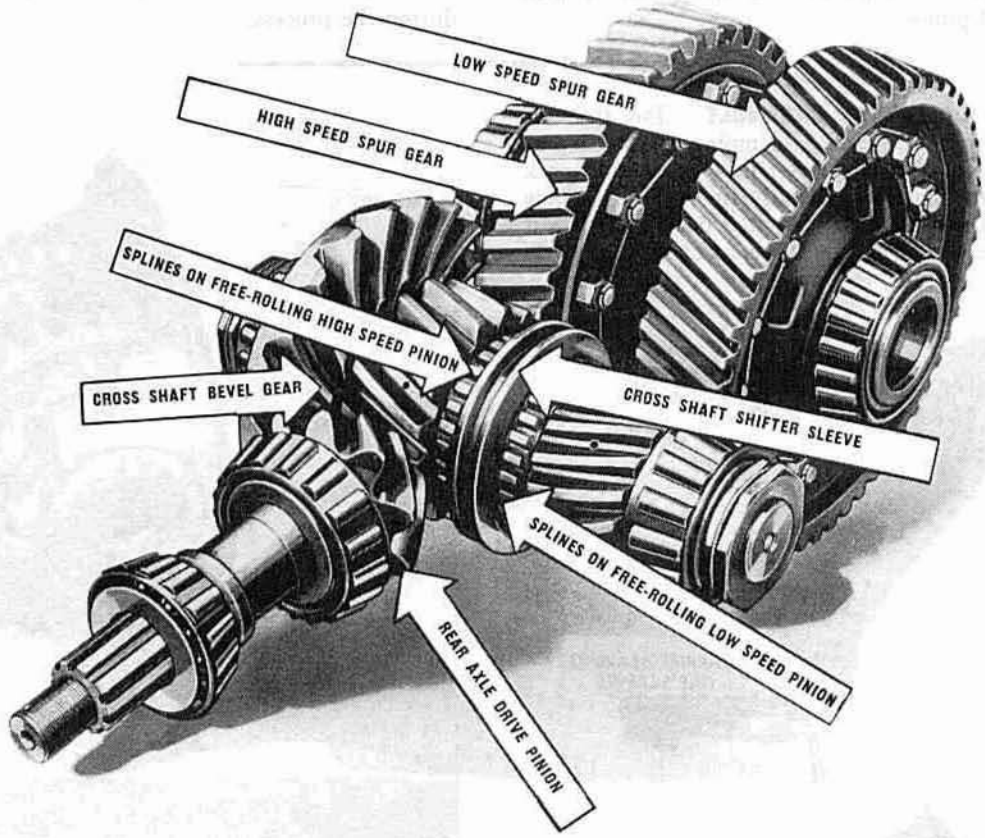
LOW SPEED SPUR GEAR
HIGH SPEED SPUR GEAR
SPLINES ON FREE-ROLLING HIGH SPEED PINION
CROSS SHAFT BEVEL GEAR
CROSS SHAFT SHIFTER SLEEVE
SPLINES ON FREE-ROLLING LOW SPEED PINION
REAR AXLE DRIVE PINION

Fig. 48

Parts of the Two-Speed Vacuum Shift Rear Axle. The Propeller Shaft Through Its Pinion, Transmits Power to the Bevel Gear, Which Actuates the Cross Shaft and High or Low Speed Pinion, the Latter Transmitting the Power to the High or Low Speed Spur Gear Through the Differential, Thence to the Axle Shafts.

OPTIONAL EQUIPMENT — M16 MODEL The Timken Two-speed Vacuum-Shift Rear Axle combines two full-size final drives of the double-reduction type in one housing. The second speed is obtained by an additional helical pinion on the cross shaft and a second spur gear on the differential. Both helical pinions float on the cross shaft, and either may be engaged by a shifter sleeve located between them and which rotates with the cross shaft. When engaged with the shifter sleeve, the pinion rotates with the shaft and drives its mating spur gear on the differential.

The shifter sleeve is operated by vacuum obtained from the intake manifold of the engine. A line conveys the power from the manifold to the control valve on the dash, via a check valve. Two vacuum power lines link the control valve with the vacuum chamber. These lines run from the slow and fast sides of the control valve to the slow and fast sides of the vacuum chamber. A vacuum supply tank is furnished as optional equipment. A speedometer shift rod on the rear of the control valve operates a speedometer shift mechanism on the speedometer to compensate for the change in road speed, when the axle speed is shifted.

OPERATION In changing from Slow to Fast axle speed, the same technique is employed as in shifting to a higher transmission range except that THE CLUTCH IS NOT USED. When road conditions permit the use of the Fast (or High) rear axle ratio, shift the selector lever to "FAST" position; this selection can be made at the driver's convenience. The shift will not be completed until the accelerator is released and the torque on the low speed driving pinion is interrupted. Closing the throttle allows the driving sleeve

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to synchronize with the high speed pinion to complete the shift.

When it is necessary to shift from Fast to Slow, the operator uses the same technique as when shifting transmission gears from a high gear into a lower gear, with the exception that THE CLUTCH IS NOT USED. Shift the selector lever to "SLOW" position, release the accelerator to interrupt the torque on the high speed pinion; then to complete the shift, accelerate the engine to synchronize the driving sleeve with the low speed pinion.

DISASSEMBLY OF CARRIER ASSEMBLY Put the carrier assembly in a bench vise, clamping the housing at the flange. To remove the differential assembly, mark the carrier bearing caps and adjustment nuts so they may be reassembled in their original positions. This is important because these caps are machined in place.

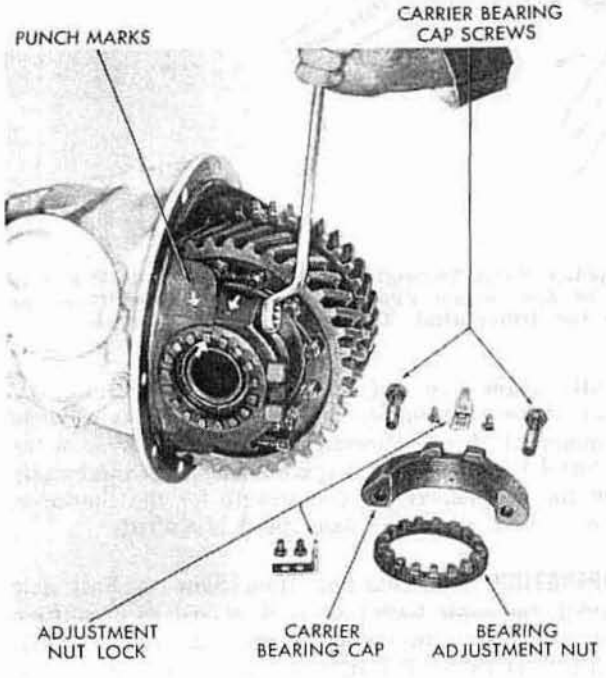

Fig. 50

Remove the differential bearing adjustment nut locks and the bearing cap screws. Then remove the bearing caps and the bearing adjustment nuts.

REMOVAL OF CARRIER ASSEMBLY To remove the differential carrier assembly, drop the propeller shaft at the forward end of the carrier assembly. Disconnect the vacuum lines at the vacuum chamber. Remove the axle shafts by removing the stud nuts at the hubs. After removing the stud nuts and stud dowels which hold the carrier to the axle housing, the carrier itself can be pulled out, using a jack to support its weight during the process.

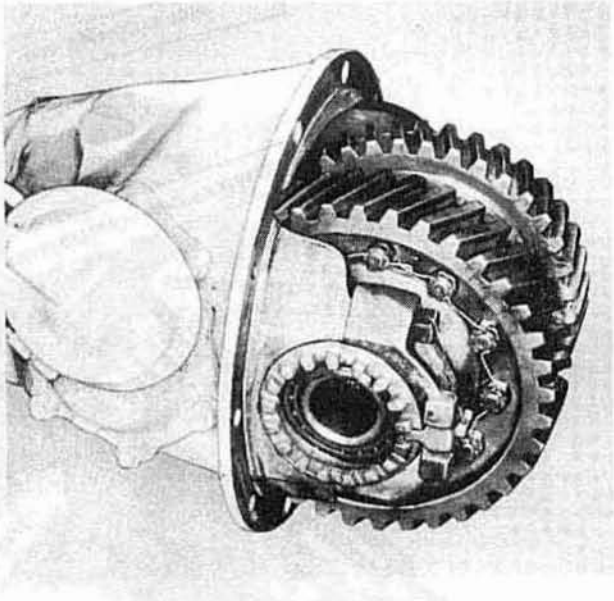

Fig. 49

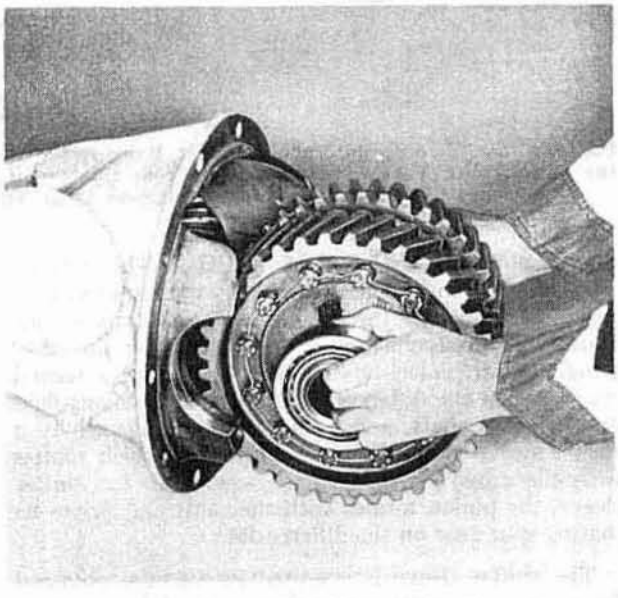

Fig. 51

The differential and gear assembly may now be removed from the carrier.

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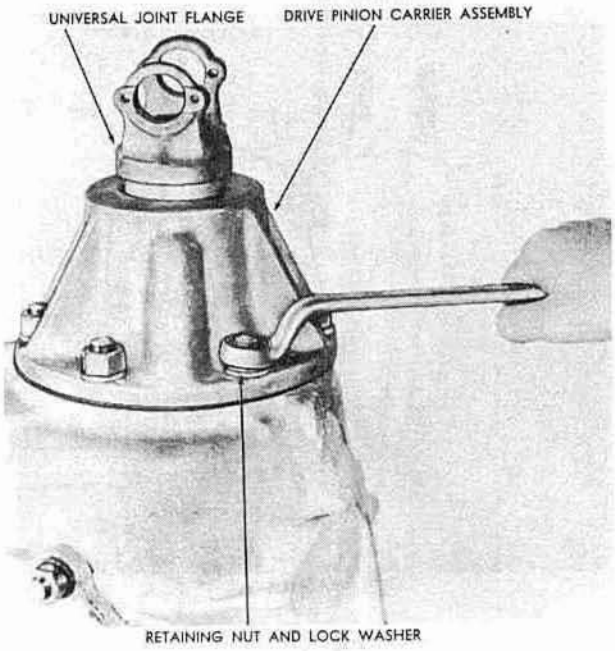

Fig. 52

To remove the drive pinion carrier assembly, remove the retaining nuts and lock washers.

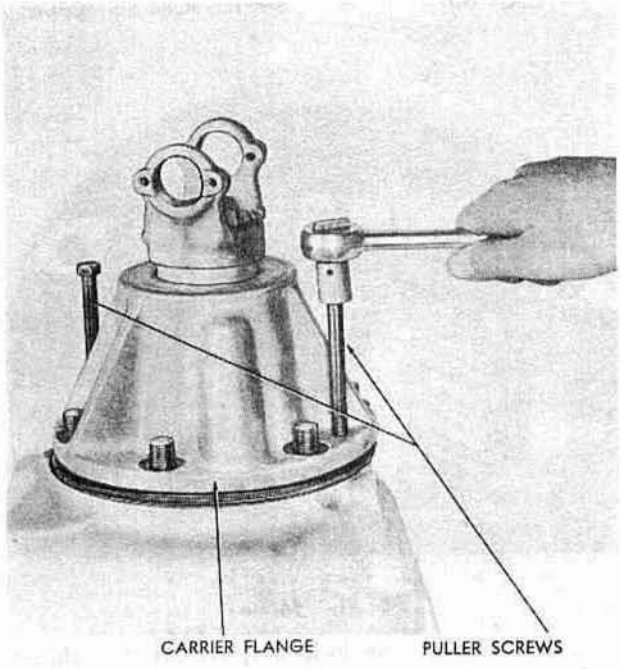

Fig. 53

Insert puller screws in the tapped holes of the carrier flange, and pull off the assembly.

Fig. 54

When removing the drive pinion carrier assembly, remember to check the number and thickness of the shims, so that in reassembling, it will be shimmed as it was originally.

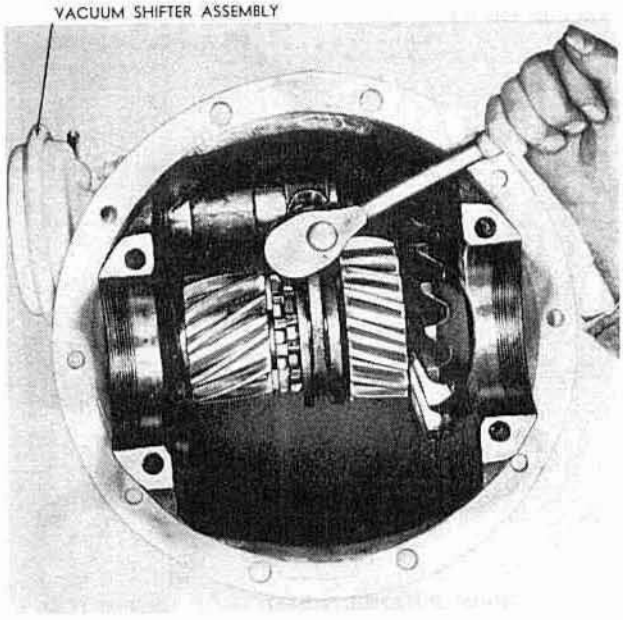

Fig. 55

To remove the vacuum shifter assembly, the first step is to loosen the shifter fork set screw lock nut.

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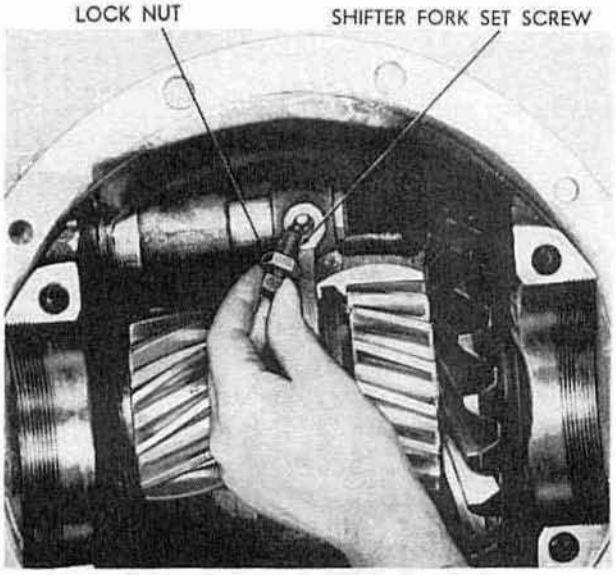

Fig. 56

After loosening the lock nut, remove the shifter fork set screw.

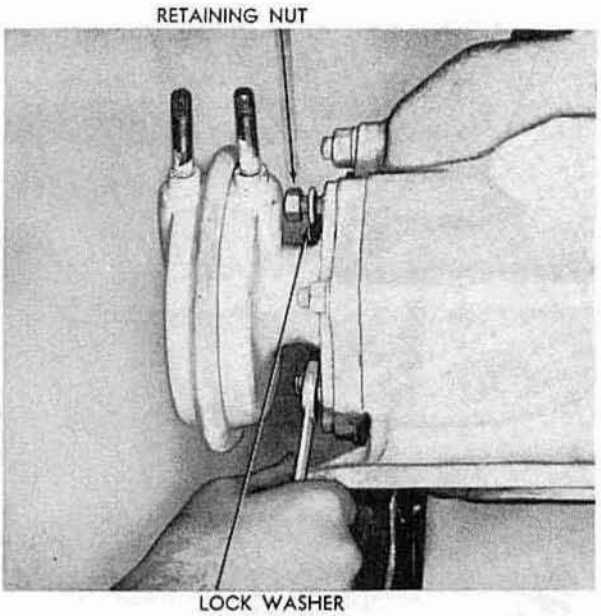

Fig. 57

Then remove the two vacuum shifter assembly retaining nuts and lock washers.

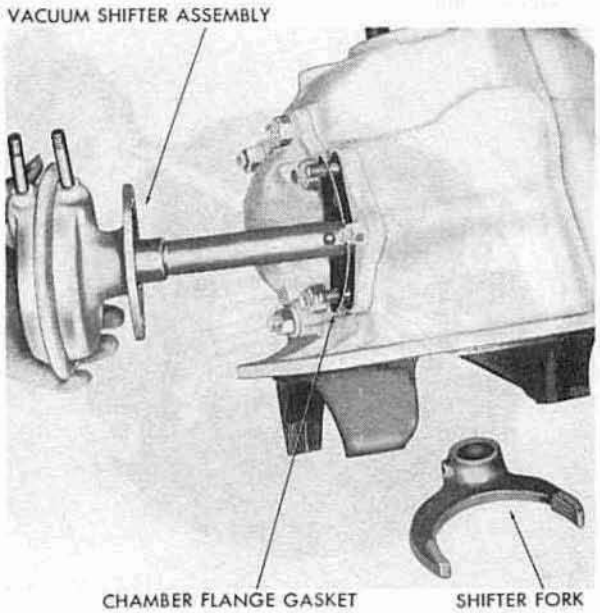

Fig. 58

The shifter assembly may now be pulled from the carrier housing.

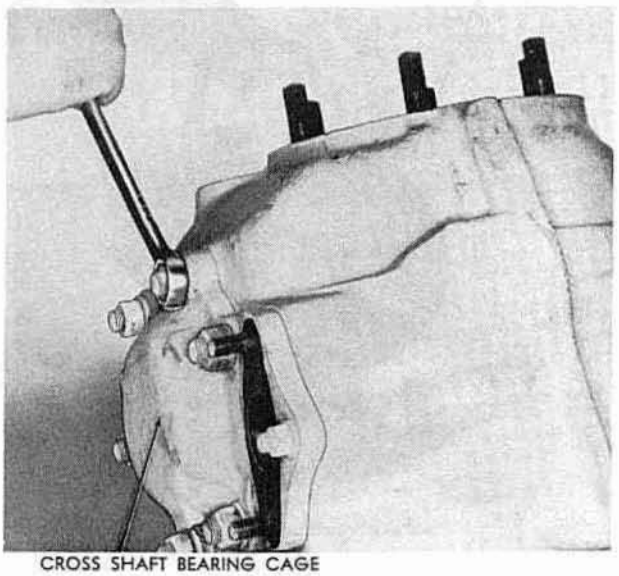

Fig. 59

To remove the cross shaft assembly, first take off the left bearing cage.

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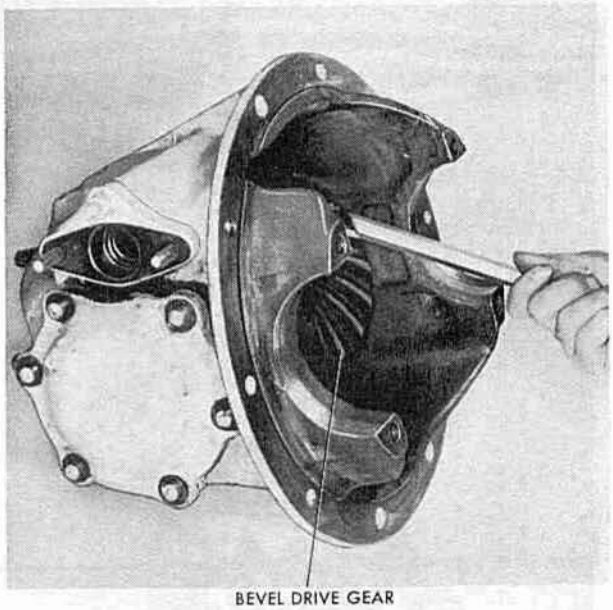

Fig. 60

A short bar can be used between the back of the bevel drive gear and the carrier housing to aid in removing the cage, which is piloted in the carrier.

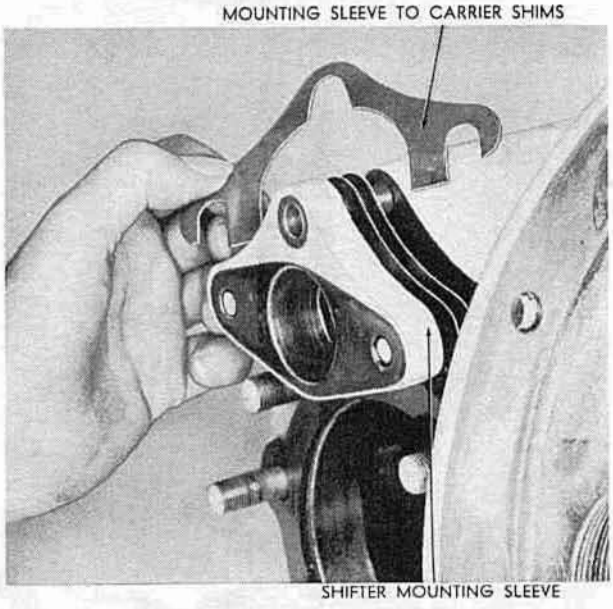

Fig. 62

To remove the vacuum shifter mounting sleeve, remove the nut and lock washer holding the mounting sleeve to the housing, and remove the adjusting shims. *Keep the shims intact as a shim pack, to insure the correct adjustment of the shifting mechanism when reinstallation is made.*

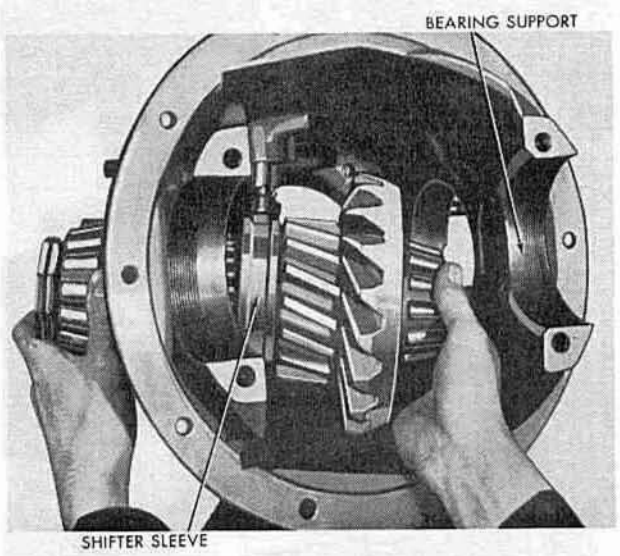

Fig. 61

With this cage removed and the shifter sleeve in the high speed position, the cross shaft, gears, and bearings, can be worked out by sliding the entire assembly to the left side of the carrier, and pulling the bevel drive gear toward the rear; then thread the assembly past the differential bearing supports.

DISASSEMBLY OF SUB-ASSEMBLIES

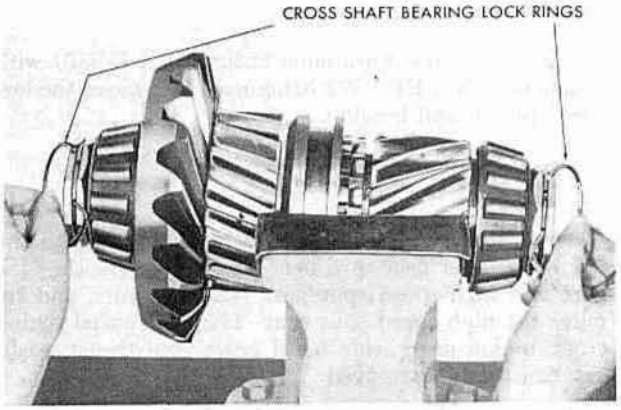

Fig. 63

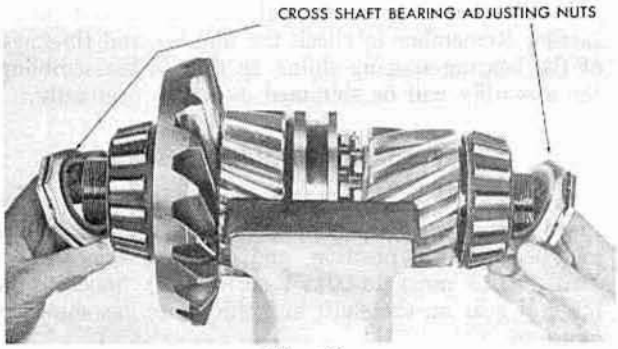

Fig. 64

To disassemble the cross shaft assembly, remove the bearing lock rings and adjustment nuts. (See figures 63 and 64.) Then remove the large snap ring from the low speed pinion.

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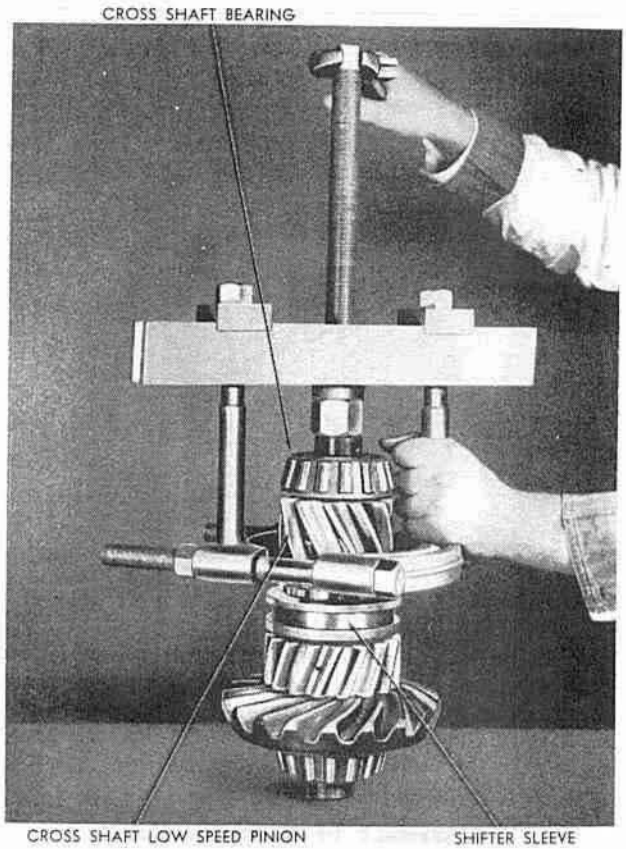

Fig. 65

Figure 65 shows Owatonna Puller No. RE-9501 with attachment No. RE-9502 being used to remove the low speed pinion and bearing.

★ ★ ★

To disassemble the differential assembly, clamp the low speed spur gear in a bench vise. Remove the lock wire and high speed spur gear retaining nuts, and remove the high speed spur gear. The differential pinion cross, pinion gears, side bevel gears, and thrust washers, can then be removed.

To disassemble the drive pinion carrier assembly, remove the universal joint flange nut and washer, and press the pinion shaft through the flange and pinion carrier. Remember to check the number and thickness of the bearing spacing shims, so that in reassembling, the assembly will be shimmed as it was originally.

ASSEMBLY AND ADJUSTMENT

To assemble the cross shaft assembly, place the high speed pinion on the shaft; then press the bevel gear and bearing into position, and obtain a clearance of .010″ (0,25 mm) to .015″ (0,38 mm) between the integral gear on the shaft and the pinion, as shown in figure 67.

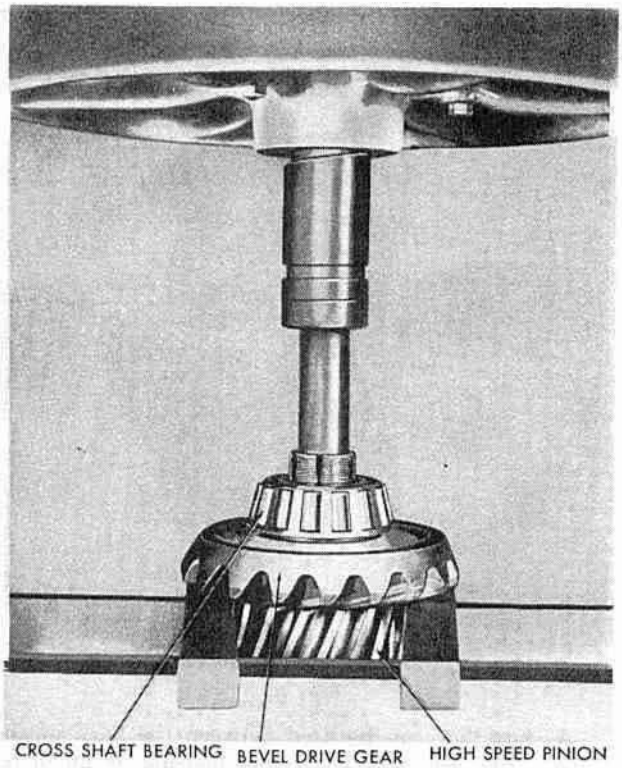

Fig. 66

Remove the shifter sleeve, being careful not to lose the three small plungers and springs. Press the shaft through the bevel gear and bearing, then remove the high speed pinion.

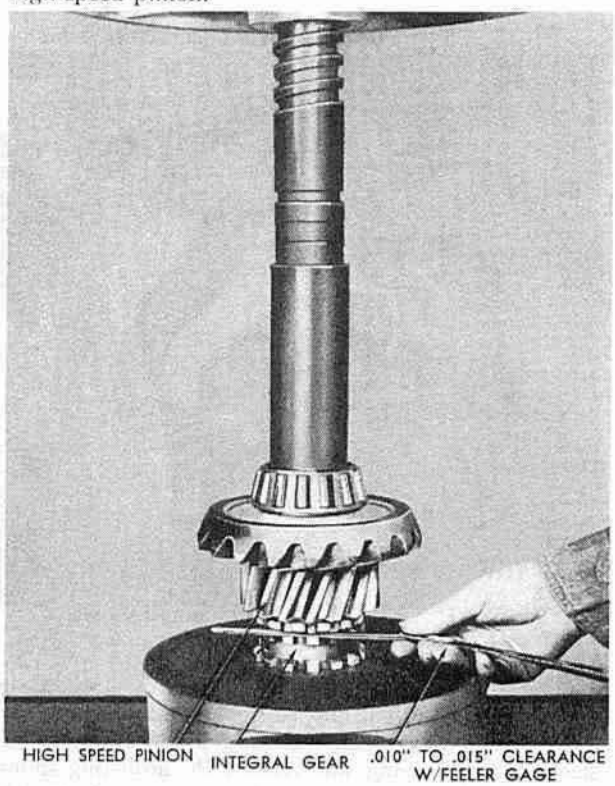

Fig. 67

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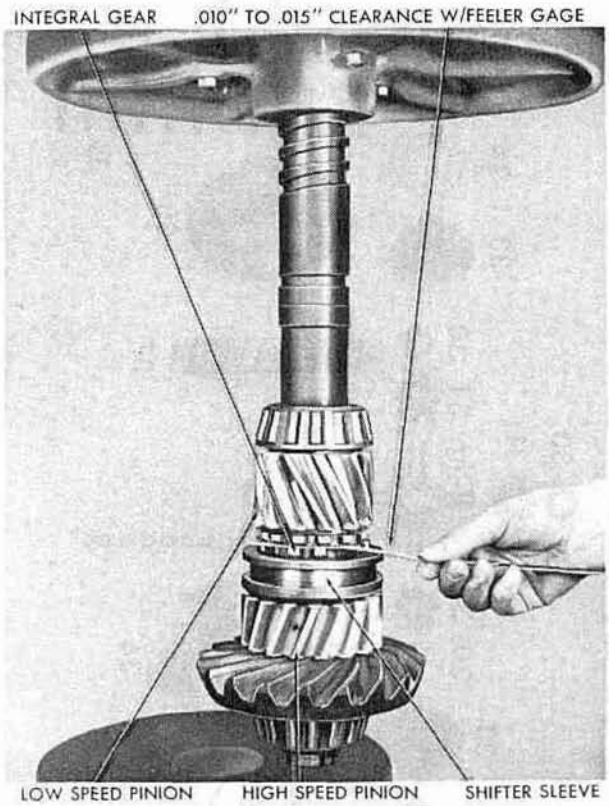

Fig. 68

Install the shifter sleeve, and the spring and plunger assemblies, placing the beveled edge of the sleeve next to the high speed pinion. Place the low speed pinion on the shaft; then press the bearing in position, allowing a clearance of .010" (0,25 mm) to .015" (0,38 mm) between the integral gear on the shaft and the pinion, as shown in figure 68. Place the unit, as assembled, in a bench vise and install the adjusting nuts on the ends of the cross shaft, placing the beveled sides of the nuts next to the bearings. After tightening the cross shaft adjustment nuts, recheck the clearance between the integral gear on the cross shaft and each pinion, to make sure that a clearance of .010" (0,25 mm) to .015" (0,38 mm) has been maintained. Install the adjustment nut lock rings and large snap ring on the low speed pinion.

To install the cross shaft assembly in the carrier housing, reverse the removal procedure.

The preloading of the cross shaft bearings is obtained by shims between the bearing cages and the carrier housing. Preload of the cross shaft bearings should be 12 to 18 inch-pounds (0,138 to 0,207 M.Kgs), which is .002" (0,050 mm) to .003" (0,076 mm) preload. (See figure 69.)

To assemble the drive pinion and carrier assembly, and install it on the carrier housing, reverse the disassembly and removal procedures. Preload of the drive pinion bearings should be 12 to 18 inch-pounds (0,138 to 0,207 M.Kgs), which is .002" (0,050 mm) to .003"

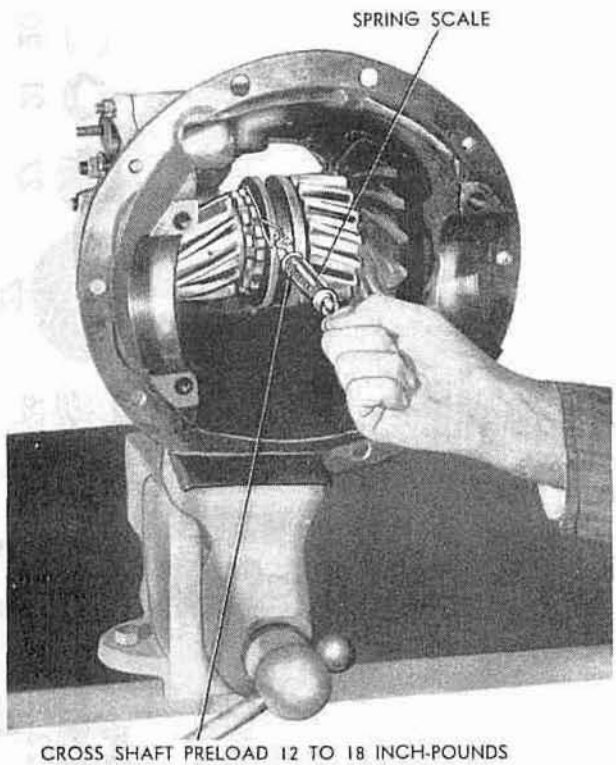

Fig. 69

(0,076 mm) preload. To eliminate the necessity of replacing and removing the universal joint flange, a piece of tubing used with the flange retaining washer and nut may be used for this operation. (See figure 70.) The oil seal should be installed after the preload is obtained.

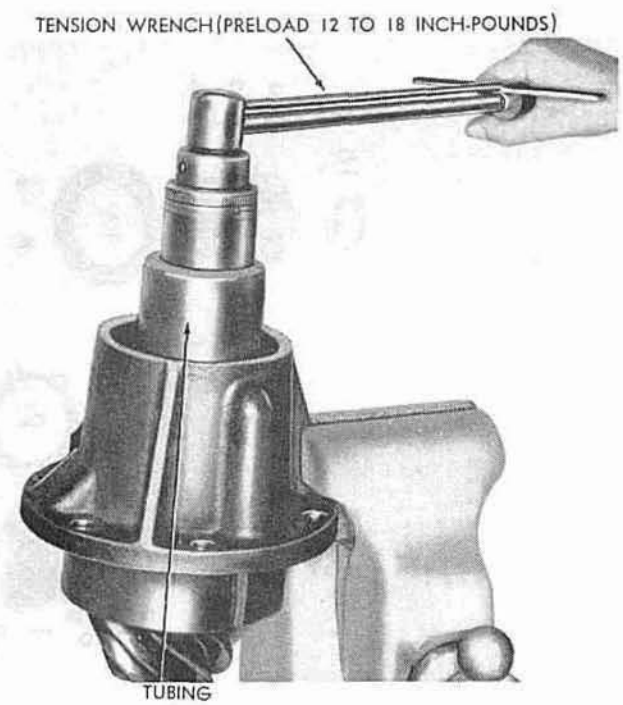

Fig. 70

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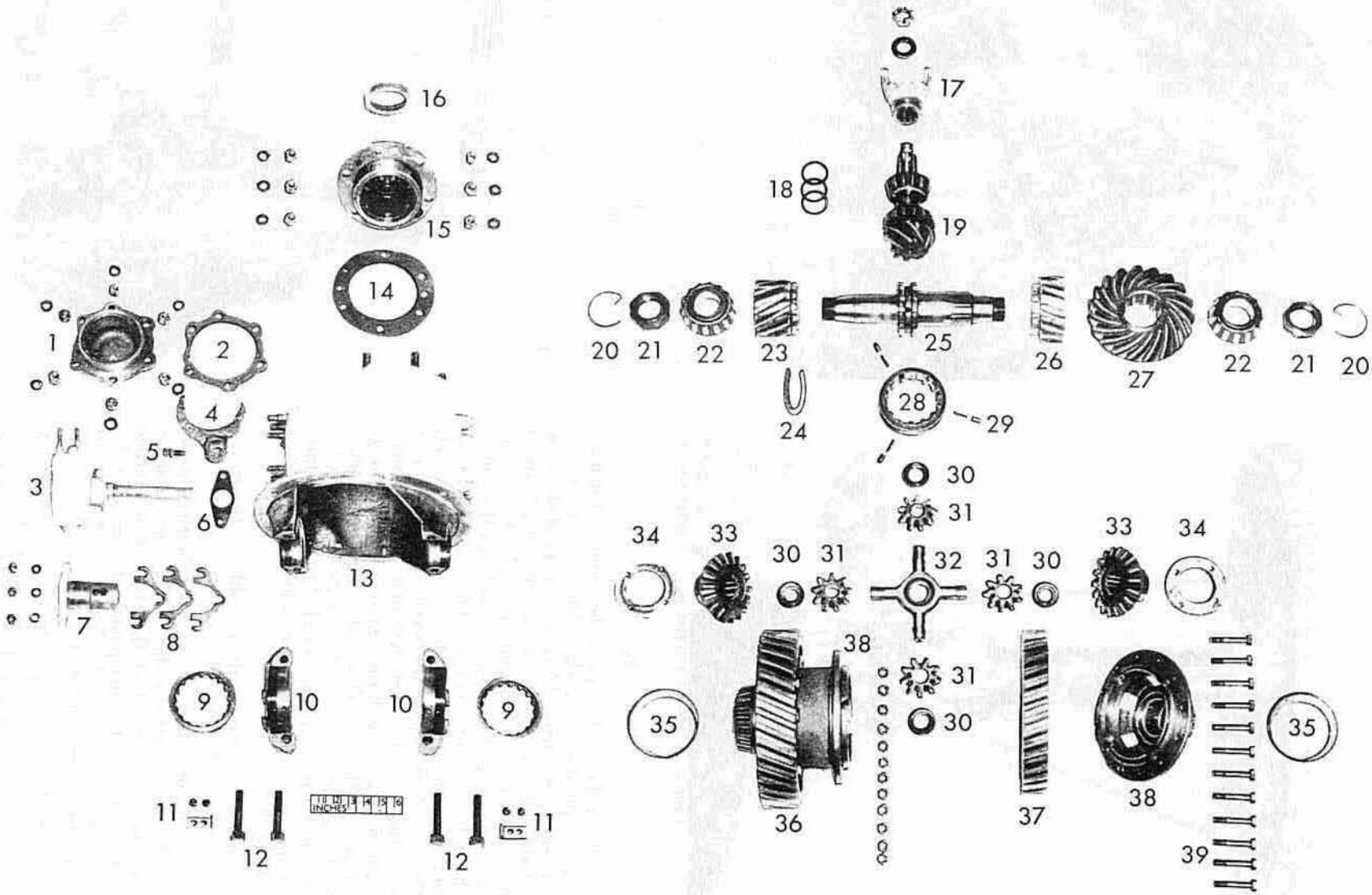

PARTS OF THE TWO-SPEED VACUUM SHIFT REAR AXLE

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LIST OF TWO-SPEED REAR AXLE PARTS

(See Fig. 71)

1. CROSS SHAFT BEARING CAGE ASSEMBLY
2. CROSS SHAFT BEARING CAGE GASKET
3. VACUUM SHIFTER ASSEMBLY
4. SHIFTER FORK
5. SHIFTER FORK SET SCREW AND LOCK NUT
6. SHIFTER ASSEMBLY TO MOUNTING SLEEVE GASKET
7. SHIFTER MOUNTING SLEEVE
8. SHIFTER MOUNTING SLEEVE TO CARRIER SHIMS
9. BEARING ADJUSTMENT NUT
10. CARRIER BEARING CAP
11. BEARING ADJUSTMENT NUT LOCK
12. CARRIER BEARING CAP SCREWS
13. DIFFERENTIAL CARRIER
14. PINION CARRIER ADJUSTING SHIMS
15. DRIVE PINION CARRIER ASSEMBLY
16. PINION BEARING OIL SEAL
17. UNIVERSAL JOINT FLANGE
18. PINION BEARING SPACING SHIMS
19. REAR AXLE DRIVE PINION AND BEARINGS
20. CROSS SHAFT BEARING LOCK RING
21. CROSS SHAFT BEARING ADJUSTING NUTS
22. CROSS SHAFT BEARING
23. CROSS SHAFT LOW SPEED PINION
24. CROSS SHAFT LOW SPEED PINION SNAP RING
25. CROSS SHAFT
26. CROSS SHAFT HIGH SPEED PINION
27. CROSS SHAFT BEVEL DRIVE GEAR
28. CROSS SHAFT SHIFTER SLEEVE
29. SPRING AND PLUNGER
30. DIFFERENTIAL PINION THRUST WASHER
31. DIFFERENTIAL PINION
32. DIFFERENTIAL PINION CROSS
33. SIDE BEVEL GEAR
34. SIDE BEVEL GEAR THRUST WASHER
35. DIFFERENTIAL BEARING CUP
36. LOW SPEED SPUR GEAR
37. HIGH SPEED SPUR GEAR
38. DIFFERENTIAL CASE
39. DIFFERENTIAL CASE TO HIGH SPEED SPUR GEAR BOLTS

(Continued from page 121)

Back lash between the cross shaft bevel gear and drive pinion should be .008" (0,20 mm) to .012" (0,305 mm). Refer to page 66 in the "M" Series Shop Manual for information on obtaining the proper tooth contact and back lash.

Install the vacuum shifter mounting sleeve, and the vacuum shifter assembly, by reversing the removal procedures, being sure to install the shims between the shifter mounting sleeve and the carrier housing.

After the vacuum shifter unit is installed, actuate the shifter fork with a bar to determine whether the shifter sleeve engages both the high and low speed pinions properly. Inspect to see that a clearance of at least .010" (0,25 mm) is maintained between the shifter fork and the walls of the shifter sleeve groove on both sides of the shifter fork, when the shifter sleeve and the pinion are engaged. This clearance is necessary to prevent friction occurring at this point and damaging the shifting mechanism. Adding or removing shims will adjust the clearance between the shifter fork and the walls of the shifter sleeve groove. These shims are available in thicknesses of .003" (0,076 mm), .005" (0,13 mm), and .010" (0,25 mm). Check to see that the shifter sleeve rests squarely against the low speed pinion snap ring when in low speed position, and against the high speed pinion when in high speed position, with no clearance. (See figure 72.)

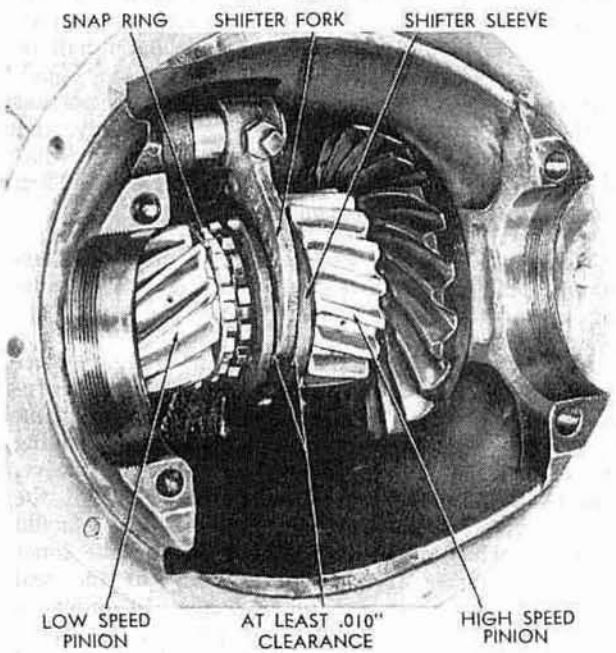

Fig. 72

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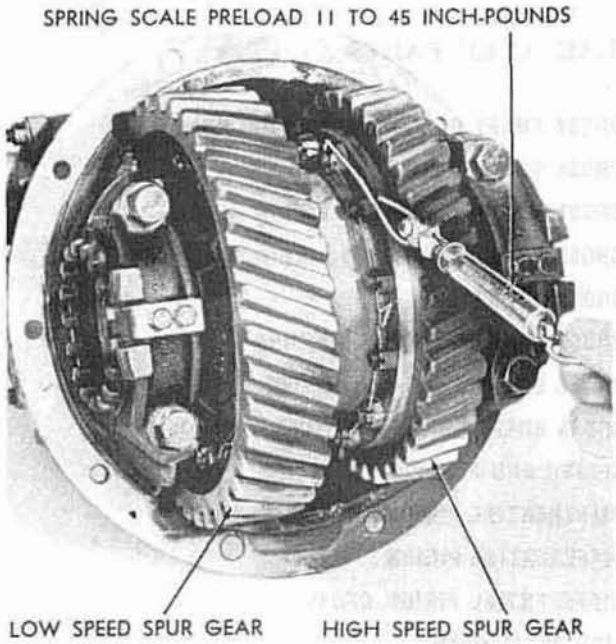

Fig. 73

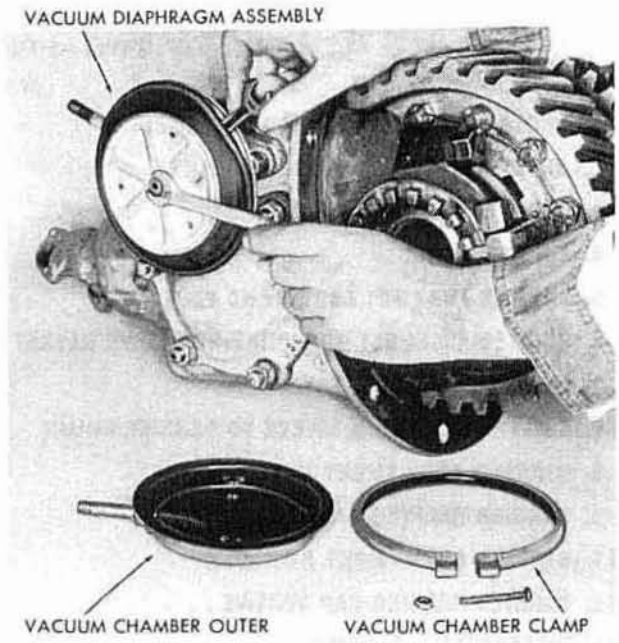

Fig. 74

To assemble the differential assembly, and install it in the carrier housing, reverse the disassembly and removal procedures. The preload of the differential bearings should be 11 to 45 inch-pounds (0,137 to 0,553 M.Kgs) which is .002″ (0,050 mm) to .007″ (0,1778 mm) carrier leg spread, and is obtained by adjusting the bearing adjustment nuts. (See figure 73.) It is important when making this adjustment to have the differential spur gears centered with the cross shaft pinion gears.

VACUUM SHIFTER DIAPHRAGM AND OIL SEAL To remove the vacuum shifter diaphragm, remove the nut, bolt, and retaining clamp, allowing the outer half of the vacuum chamber to be removed. Use a 3/8-inch (9,5 mm) end wrench to hold the hexagonal portion of the push rod behind the diaphragm assembly, and with a 1/2-inch (12,7 mm) wrench remove the diaphragm plate to push rod nut. (See figure 74.) Then remove the diaphragm assembly.

When replacing the vacuum shifter diaphragm assembly, place the concave side toward the carrier housing.

If any signs of oil are noticed on the vacuum shifter diaphragm, the shifter assembly oil seal must be replaced. To remove the inner half of the vacuum chamber, remove the two nuts and lock washers holding the chamber flange to the shifter mounting sleeve, and to the carrier housing. The inner half of the vacuum chamber may then be removed. Care should be taken when reinstalling the oil seal in the inner vacuum chamber to see that the lip of the seal is placed toward the chamber flange. In order to eliminate damage to the oil seal, place a thin piece of shim stock or paper around the inside of the seal when reinstalling the chamber. (See figure 75.)

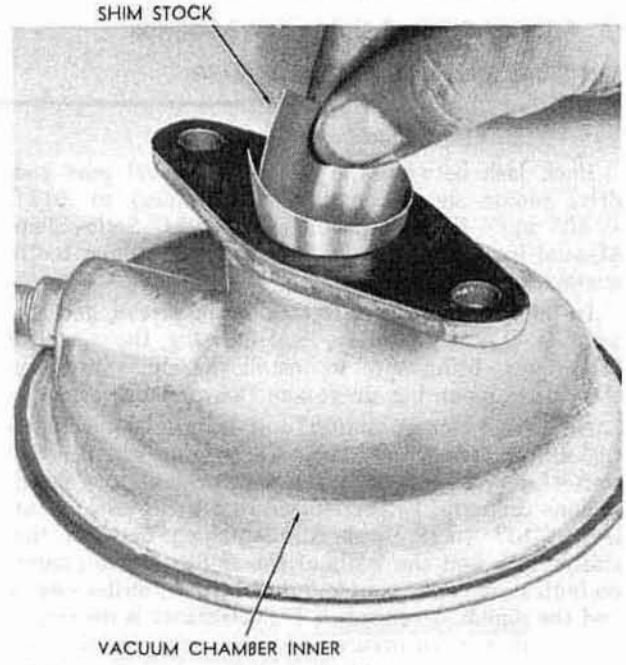

Fig. 75

LUBRICATION When filling the differential carrier assembly with gear lubricant, put one pint of gear lubricant in the pinion carrier assembly also, through the filler plug hole provided.

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DISASSEMBLY OF THE VACUUM SHIFTER UNIT (REMOVED FROM THE CARRIER

1. Remove the nut and clamp bolt from the vacuum chamber clamp and remove the outer half of the vacuum chamber.

2. Hold the push rod with a 3/8" end wrench placed on the hexagonal part of the push rod between the diaphragm assembly and the inner half of the vacuum chamber, and using a 1/2" wrench, remove the diaphragm plate to push rod nut. Then remove the diaphragm assembly from the push rod and the inner half of the vacuum chamber from the shifter rail.

3. Remove the snap ring which holds the push rod assembly in the shifter rail and pull the push rod assembly out of the shifter rail.

4. Remove the shifter rail washer from the outer end of the push rod and the lock nut and adjusting nut from the inner end. The push rod spring spacers, the push rod sleeve, and the push rod spring can then be removed from the push rod.

INSPECTING AND REPAIRING THE VACUUM SHIFTER UNIT

Thoroughly clean all parts in a cleaning solvent and remove any traces of rust or corrosion. Inspect the diaphragm for holes or other signs of deterioration. If it is damaged, it must be replaced. If any traces of oil are noticed on the diaphragm, the shifter rail oil seal assembly must be replaced. Inspect the shifter rail for signs of abrasion and, if necessary, stone it smooth (do not use emery cloth). Check the shifter fork to see that the fork arms are not bent and are on a true plane. Replace any worn or damaged parts.

REASSEMBLY OF THE VACUUM SHIFTER UNIT

1. Place one of the push rod spring spacers on the push rod against the shoulder of the hexagonal part of the rod.

2. After packing the push rod spring with light grease, place the spring on the push rod against the push rod spring spacer.

3. Cover the push rod spring sleeve with light grease and install the sleeve over the spring on the push rod.

4. Place the other push rod spring spacer on the push rod against the push rod spring. Install the adjusting nut and draw it up until there is a slight tension on the push rod spring. Then install the lock nut and tighten it securely.

5. Place the shifter rail washer on the outer end of the push rod against the push rod spring spacer and install the push rod assembly in the shifter rail. Then install the snap ring which holds the push rod assembly in the shifter rail.

6. Check the push rod assembly for end play in the shifter rail. If any end play exists, again remove the push rod from the shifter rail and lessen the push rod spring tension by backing off the adjusting nut. If there is no perceptible end play when the push rod assembly is installed in the shifter rail, the push rod spring is correctly adjusted.

7. Install the inner half of the vacuum chamber on the shifter rail, being sure not to damage the shifter rail oil seal.

8. Install the diaphragm assembly on the push rod and secure it in place with the push rod nut.

9. Place the outer half of the vacuum chamber in position, aligning the two vacuum fittings. Then assemble the vacuum chamber clamp ring, bolt, and nut, and tighten the nut securely.

NOTE.--When installing the shifter rail oil seal in the inner half of the vacuum chamber, use the large end of Bearing Puller Adapter HM-872-5 to seat the seal properly.

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SERVICE DIAGNOSIS

Condition	Cause	Correction
1. Failure of axle to shift into fast or slow gear ratio	Low vacuum due to leaks, clogged lines, etc.	Make necessary repairs to increase vacuum in vacuum chamber assembly to a minimum of 15 inches Hg.
	Defective diaphragm	Replace diaphragm.
	Burrs on teeth of cross shaft pinions, cross shaft shifter sleeve, or cross shaft integral gears; rough shifter sleeve plunger (detent) surfaces	Remove burrs or roughness so that shifter sleeve moves freely from one pinion to another.
	Binding in shifter rail	Remove cause of binding.
	Bent inner half of vacuum chamber	Straighten or replace inner chamber.
	Burrs in shifter mounting sleeve	Remove burrs with very fine hone.
2. Failure of axle to shift into fast gear ratio	Any of the above causes or defective shifter rail oil seal assembly	If other causes are not apparent, replace oil seal assembly.
3. Axle jumps out of slow gear ratio	Cross shaft shifter sleeve not fully engaging low speed pinion	Correctly adjust shifter fork travel.
	Worn teeth on cross shaft shifter sleeve or low speed pinion	Replace worn parts.
	Broken or weak plunger (detent) springs	Replace plunger (detent) springs.
4. Axle jumps out of fast gear ratio	Cross shaft shifter sleeve not fully engaging high speed pinion	Correctly adjust shifter fork travel.
	Worn teeth on cross shaft shifter sleeve or high speed pinion	Replace worn parts.
	Broken or weak plunger (detent) springs	Replace plunger (detent) springs.
5. Oil leak at control (selector) valve on dash	Worn or damaged shifter rail oil seal assembly	Replace oil seal. Also check inner half of vacuum chamber for bent or sprung mounting surface.
6. Failure of cross shaft shifter sleeve to disengage the low or high speed pinion	Binding in shifter rail	Remove cause of binding.
	Shifter fork set screw loose	Tighten set screw securely.
	Burrs on teeth of cross shaft pinions, cross shaft shifter sleeve, or cross shaft integral gears; rough shifter sleeve plunger (detent) surfaces	Remove burrs or roughness so that shifter sleeve moves freely from one pinion to another.
	Low vacuum due to leaks, clogged lines, etc.	Make necessary repairs to increase vacuum in vacuum chamber assembly to a minimum of 15 inches Hg.

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AXLE SHAFT BEARINGS

LUBRICATION—M5 MODEL Axle shaft bearings should be lubricated with *wheel bearing lubricant* at 10,000 mile (16.090 km) intervals.

After truck serial number M5-5000, the axle housing is equipped with a pipe plug near each brake backing plate, instead of a lubrication fitting. There is a 7/64" (2,778 mm) vent hole located above each pipe plug hole (see figure 76). Open the vent holes with a piece of wire, temporarily remove the plugs, and install lubrication fittings. Lubricate with a low-pressure hand gun or a pressure gun equipped with a pressure control extension coupling (maximum pressure setting not to exceed 1500 to 1600 pounds [1607 to 1714 kgs]) until the lubricant is forced out the vent holes. After the lubrication has been completed, remove the lubrication fittings and reinstall the pipe plugs.

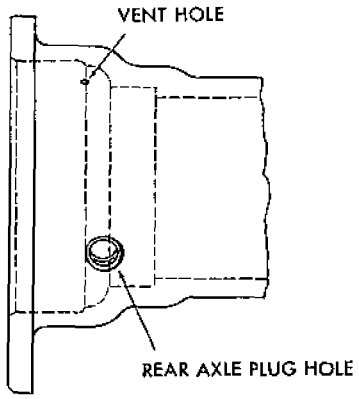

Fig. 76

STEERING

FRONT AXLE

GENERAL—M15 AND M15A MODELS A Timken 29502 front axle is used after truck serial number M15-2000, and on the M15A from the start of production. This axle differs from the M15 axle specified on page 72, in that the steering knuckle wheel spindles are of slightly heavier construction. Larger wheel bearings are also used.

SPRINGS

SPRING SPECIFICATIONS

	Wheel Base	Type	Length	Width	No. of Leaves	Deflection Rate Lbs. Per Inch	Thickness at Center
M5 After truck Ser. M5-5000	113"	Front Std.	36" (0,9 m)	1-3/4" (44,5 mm)	8	265	1.834" (46,58 mm)
	113"	Front H. D.	36" (0,9 m)	1-3/4" (44,5 mm)	9	310	2.106" (53,49 mm)
	113"	Rear Std. (Two Stage)	51" (1,29 m)	1-3/4" (44,5 mm)	11	180 (Main) 210 (Comb.)	2.977" (25,61 mm)
	113"	Rear H. D. (Two Stage)	51" (1,29 m)	1-3/4" (44,5 mm)	12	200 (Main) 230 (Comb.)	3.275" (83,19 mm)
M15 From truck Ser. M15-2000 through truck Ser. M15-6400	120" & 128"	Front	36" (0,9 m)	2" (50,8 mm)	6	385	1.733" (44 mm)
	120"	Rear	45" (1,14 m)	2-1/2" (63,5 mm)	8	550	2.391" (60,7 mm)
	128"	Rear	45" (1,14 m)	2-1/2" (63,5 mm)	8	650	2.625" (66,7 mm)
	120"	Auxiliary	33" (0,83 m)	2-1/2" (63,5 mm)	7	600	1.666" (42,3 mm)
	128"	Auxiliary	33" (0,83 m)	2-1/2" (63,5 mm)	10	1000	2.506" (63,6 mm)
M15A From the start of production (Truck Ser. M15A-6401)	120" & 128"	Front Std.	36" (0,9 m)	2" (50,8 mm)	6	385	1.495" (37,97 mm)
	120"	Rear Std.	45" (1,14 m)	2-1/2" (63,5 mm)	8	550	2.391" (60,7 mm)
	120"	Rear H. D.	45" (1,14 m)	2-1/2" (63,5 mm)	15	1150	4.057" (103,0 mm)
	128"	Rear Std.	45" (1,14 m)	2-1/2" (63,5 mm)	8	1650	5.131" (130,3 mm)
M16 After truck Ser. M16-5200	128" & 152"	Front Std.	36" (0,9 m)	2" (50,8 mm)	10	560	2.447" (62,15 mm)
	195"	Front Std.	36" (0,9 m)	2" (50,8 mm)	11	625	2.706" (68,7 mm)
	128" & 152"	Front H. D.	36" (0,9 m)	2" (50,8 mm)	11	625	2.706" (68,7 mm)
	195"	Front H. D.	36" (0,9 m)	2" (50,8 mm)	12	700	2.965" (75,3 mm)
	All	Rear Std.	45" (1,14 m)	2-1/2" (63,5 mm)	22	2260	6.475" (164,5 mm)
	All	Rear H. D.	45" (1,14 m)	2-1/2" (63,5 mm)	24	2535	7.162" (181,9 mm)

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BRAKES

REAR BRAKE ADJUSTMENT

M15, M15A, AND M16 MODELS Complete step-by-step adjustment instructions are covered on pages 85 and 86. The importance of following through the exact adjustment sequence given cannot be over-emphasized.

In most cases, reports of unsatisfactory rear brake operation are directly traceable to faulty adjustment. This is undoubtedly due to a misconception that correct adjustment for lining wear is made at the star wheel. Although the wheel is similar to that which has been used on Bendix brakes for many years, ADJUSTMENT OF THE STAR WHEEL ALONE WILL NOT PROVIDE CORRECT LINING WEAR ADJUSTMENT ON THE HI-TORK HYDRAULIC BRAKE USED ON THE *M15, M15A, AND M16* MODELS. (Make a notation on pages 85 and 86 referring to this caution note.)

PARKING BRAKE — DISC-TYPE

OPTIONAL EQUIPMENT—M16 MODEL The Disc-type Parking Brake employs a drop-forged steel disc mounted on the universal joint flange which rotates with the propeller shaft when the truck is in motion.

ADJUSTMENT When necessary to adjust the Disc-type Parking Brake, use the following procedure:

1. Remove the clevis pin from the rear end of the hand-lever-to-parking-brake rod.
2. Loosen the lever rod lock nut. Tighten the lever rod spherical nut so that the lever arm release spring exerts enough pressure to bring the operating lever to stop solidly against the front shoe lever.
3. Insert a 1/32" (0,794 mm) shim or feeler gage between the front brake shoe and the disc at the center of the lining.
4. Insert a second 1/32" (0,794 mm) shim or feeler gage between the rear brake shoe and the disc at the center of the lining, and continue tightening the spherical nut until a clearance of 1/32" (0,794 mm) is obtained.
5. The shoe spring linking the bottom of the brake shoes must be in good condition. Adjust the shoe adjusting screws at the top of the brake shoes so the two linings are parallel with the disc and have a clearance of 1/32" (0,794 mm).
6. Remove the shims or feeler gages. Set the hand brake lever in full released position, then adjust the hand-lever-to-parking-brake rod so the clevis pin can be installed in the operating lever without changing the position of the operating lever.

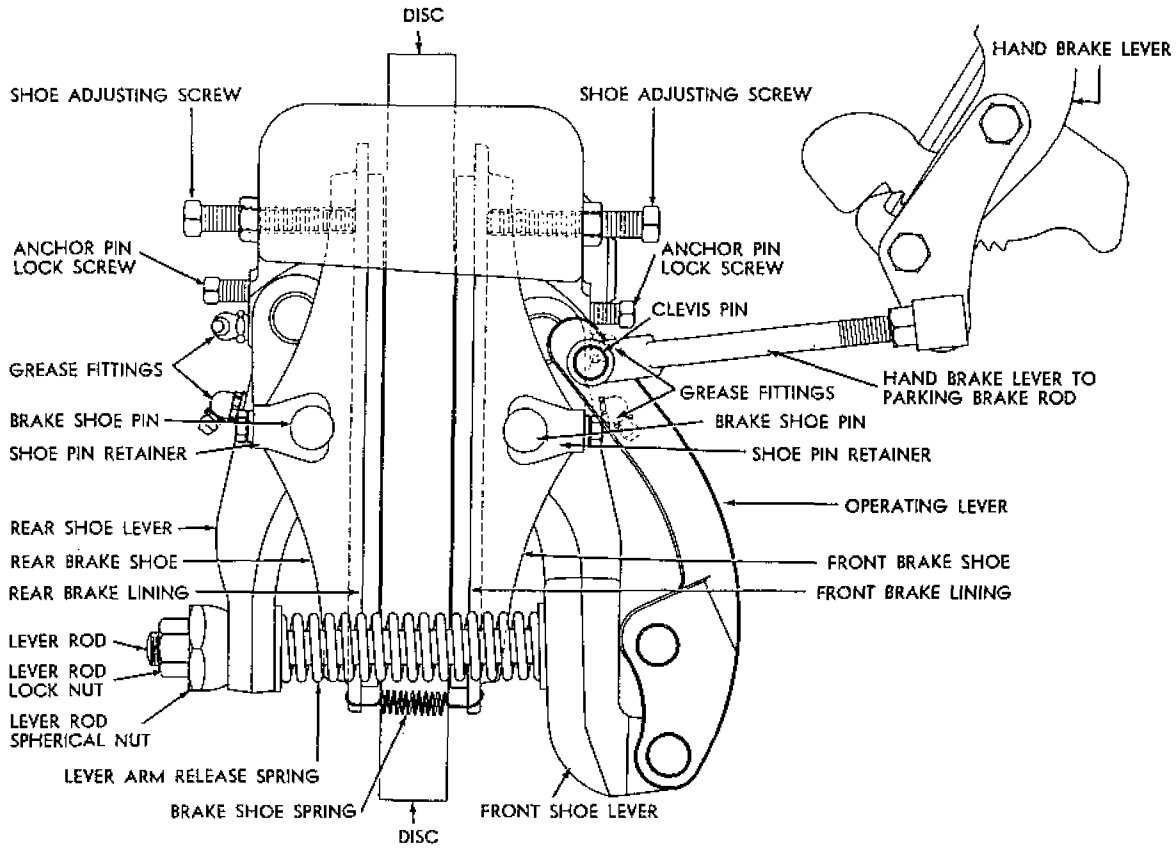

Fig. 77

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RELINING When it is necessary to reline the Disc-type Parking Brake, the procedure given below should be followed:

1. Remove the lever rod lock nut and spherical nut.
2. Remove the brake shoe spring.
3. Apply the hand brake lever so that the rear shoe lever can be swung back clear of the lever rod and the lever arm release spring.
4. Remove the brake shoe pin retainers and pins, and remove the brake shoes.
5. Replace the relined shoes and follow the adjustment procedure given previously.

IMPORTANT When relining the Disc-type Parking Brake, always use the special linings available from Studebaker Parts and Accessories Division or Studebaker Parts Depots. Ordinary wheel brake lining will not give the performance for which the brake is designed.

BRAKE BOOSTER UNIT

OPTIONAL EQUIPMENT—M16 MODEL A Bendix Vacuum-Operated Brake Booster, Model R60-6, is furnished as optional equipment on the M16 model. The vacuum necessary to operate the booster unit is obtained from the intake manifold of the engine.

OPERATION When the brakes are off and the engine is running, a vacuum is present on both sides of the booster piston. Depressing the brake pedal admits atmospheric pressure to one end of the cylinder, causing the piston to move toward the end of the cylinder in which a vacuum still exists. Power thus developed is transmitted to the master cylinder to assist in the hydraulic application of the brakes through a direct pull on a lever attached to the master cylinder piston rod. Upon releasing the brake pedal, vacuum is again present on each side of the booster piston, allowing the return spring to push the piston back to its off position, thereby releasing the pressure on the master cylinder piston rod.

The booster unit is of the reactionary type; that is, a small portion of the booster power transmitted to the hydraulic master cylinder is "fed back" through the brake pedal to the driver's foot. This "fed back" power develops in direct proportion as the amount of braking power applied by the booster unit increases; therefore, the driver can instantly determine by "feel" the degree of brake application.

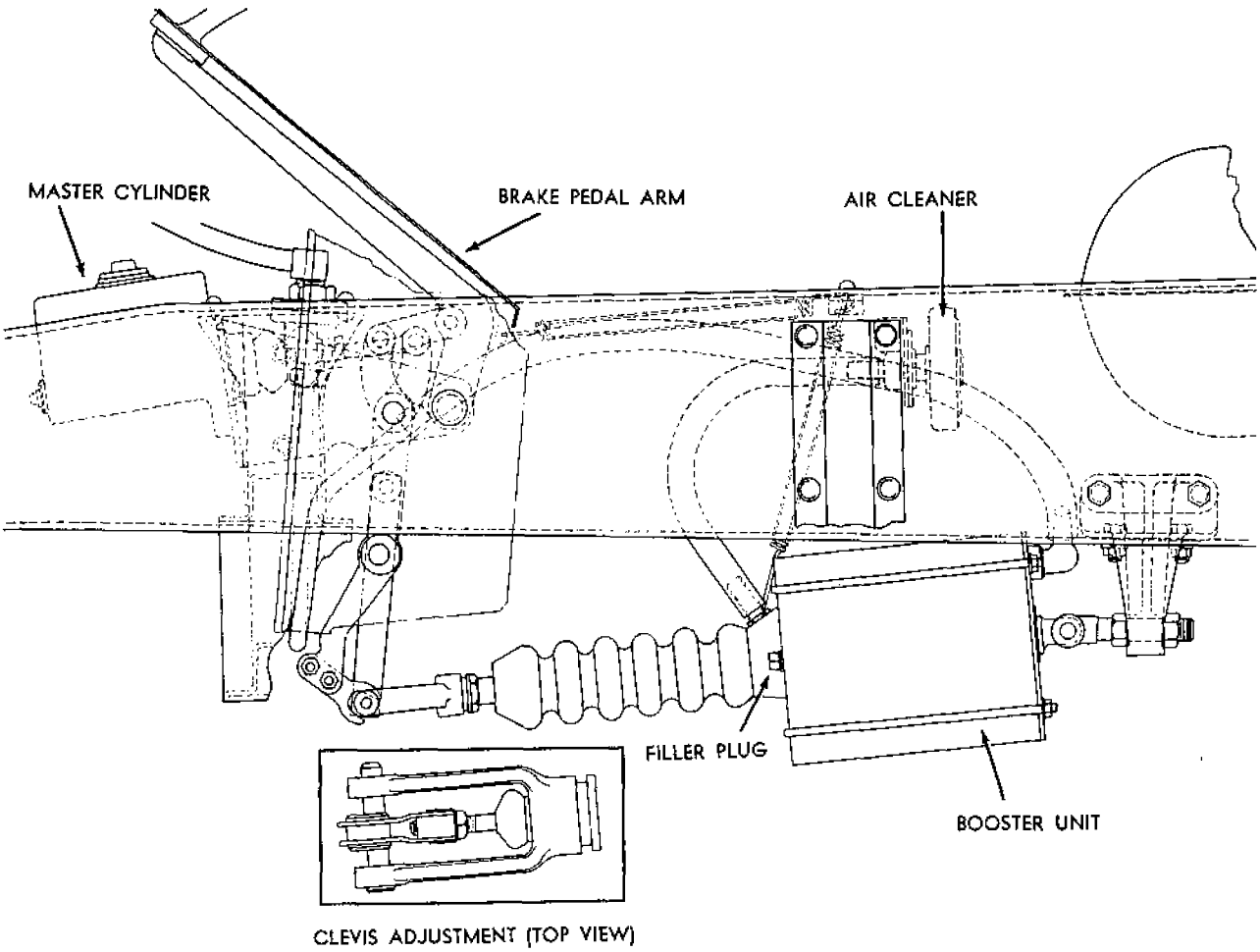

Figure 78 Illustrates the Brake Booster Unit and Linkage as Installed on the M16 Model.

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ADJUSTMENT In order to obtain an accurate adjustment of the Vacuum Brake Booster, the special adjusting bushing shown in figure 80 should be used. This adjusting bushing (part number T25111) may be obtained from your nearest Bendix distributor; or from the General Service Department, The Studebaker Corporation, South Bend 27, Indiana; or it may be desirable to make the bushing locally.

The following adjustment procedure should be used:

1. Insert the special adjusting bushing tool in the valve rod yoke, as illustrated in figures 79 and 80. Push the valve and yoke in the applied direction toward the cylinder, as indicated by the large arrow in figure 80. The valve rod will move quite easily until the vacuum valve has seated and the washer and pin have contacted the atmospheric valve. This is the lap or holding position (both valves closed). Considerably greater effort is required to move the valve rod in the applied direction beyond the lap position. It is, therefore, very easy to "feel" the lap position. (See figure 79.)

2. With the valve held in lap position, the hole in the adjusting bushing must line up with the holes in the piston rod yoke (see "F" in figure 80), so that the clevis pin can be inserted freely.

3. If the holes do not line up, loosen the valve rod yoke lock nut (see "G" in figure 80), and adjust the yoke position to line up the holes in lap position; tighten the lock nut securely.

NOTE: If for any reason the position of the piston rod yoke is changed after the valve adjustment, it will be necessary to repeat the valve rod yoke adjustment.

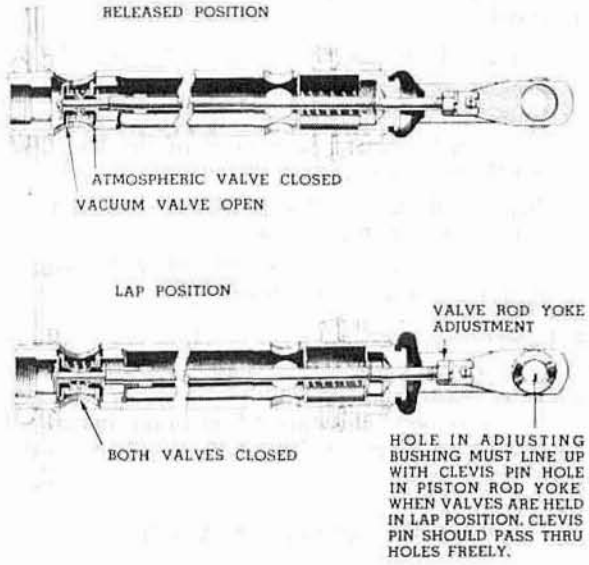
RELEASED POSITION
ATMOSPHERIC VALVE CLOSED
VACUUM VALVE OPEN
LAP POSITION
VALVE ROD YOKE ADJUSTMENT
BOTH VALVES CLOSED
HOLE IN ADJUSTING BUSHING MUST LINE UP WITH CLEVIS PIN HOLE IN PISTON ROD YOKE WHEN VALVES ARE HELD IN LAP POSITION. CLEVIS PIN SHOULD PASS THRU HOLES FREELY.

Fig. 79

VACUUM CYLINDER LUBRICATION Two ounces (59,15 cu. cm.) of Bendix B-K Vacuum Cylinder Oil should be injected through the pipe plug hole in the valve end of the booster unit once each year.

AIR CLEANER The type of roads over which the truck is operated and the service to which it is subjected will determine how often it will be necessary to service the booster air cleaner.

To remove the air cleaner from its support bracket, place a wrench on the hexagonal section at the rear of the unit and turn the cleaner in a counter-clockwise direction.

To service the air cleaner, remove the snap ring, washer, cover, and filter pack. Wash the filter pack and screen in kerosene, and drain thoroughly. Dip the filter pack in Bendix B-K Vacuum Cylinder Oil and reassemble the unit.

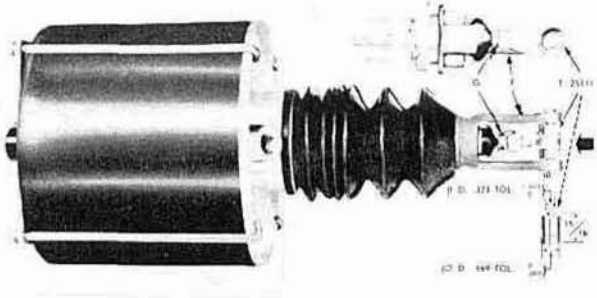

Fig. 80

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BRAKE POWER UNIT (HYDROVAC)

Optional equipment for MI6

GENERAL

The Hydrovac consists of three basic units combined to function as a single unit. The three basic units are controlled by hydraulic pressure developed within the master cylinder of the vehicle.

The three basic units are:

1. A hydraulically actuated vacuum control valve which controls the degree of brake application or release. The control valve consists of a hydraulic-actuated piston, a diaphragm, a vacuum poppet, and an atmospheric poppet.
2. A hydraulic cylinder which contains a piston with a check valve.
3. A vacuum power cylinder which contains a single piston and a push rod that connects the vacuum piston to the hydraulic piston of the hydraulic cylinder.

As the brake pedal is depressed, the hydraulic pressure developed within the master cylinder is transmitted to the hydraulic piston of the control valve and to the hydraulic cylinder. With pressure applied to the control valve piston, the vacuum valve closes and the atmospheric valve opens to admit air to the control side of the vacuum power cylinder. As air is admitted, the force acting upon the vacuum power cylinder piston is transmitted directly to the hydraulic piston through the push rod. As the hydraulic piston starts to move, the piston check valve closes, trapping fluid under pressure ahead of the piston.

The total hydraulic pressure created and transmitted to the wheel cylinder is the sum of the pressure developed as a result of the vacuum power cylinder push rod thrust and the pressure received by the Hydrovac from the master cylinder.

As the brake pedal is released, the pressure within the control valve hydraulic piston chamber is reduced, allowing the atmospheric poppet to close and reopen the vacuum poppet. The vacuum power cylinder piston is again balanced in vacuum and returns to the release position. When the hydraulic piston nears the release end of its stroke, its check valve reopens, thus permitting full release of the brakes.

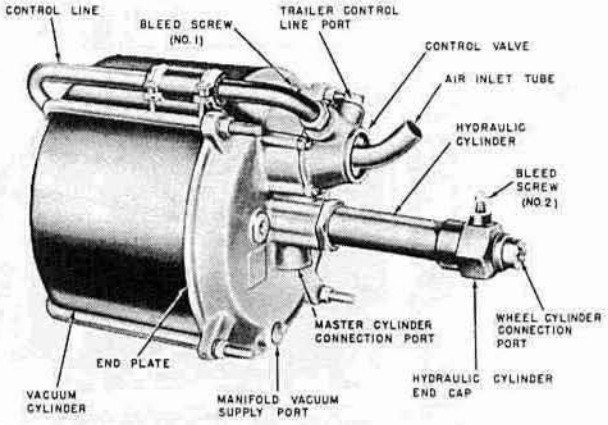

Fig. 1—Single piston Model C Hydrovac

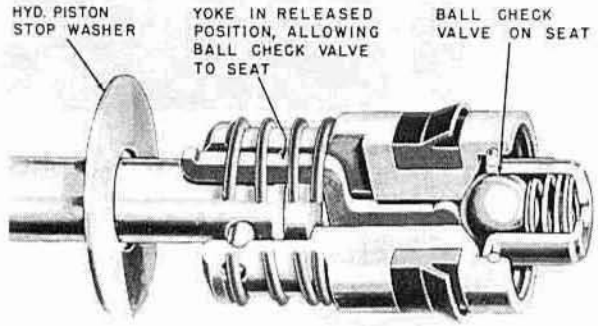

Fig. 2—Hydraulic piston in applied position

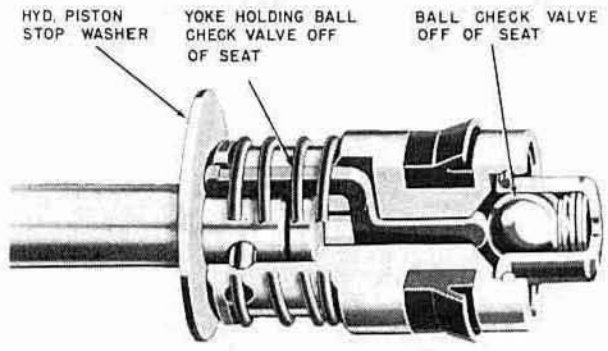

Fig. 3—Hydraulic piston in released position

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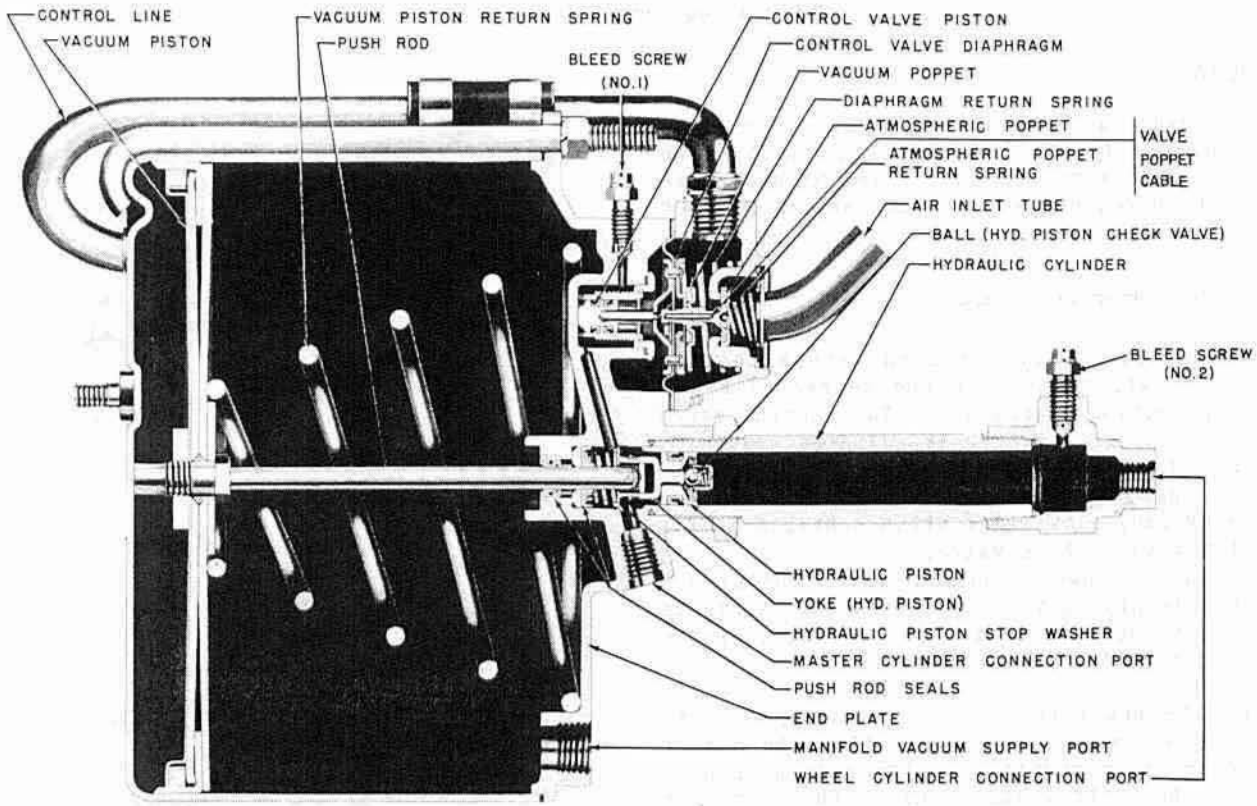

Fig. 4— Sectional view of the Hydrovac

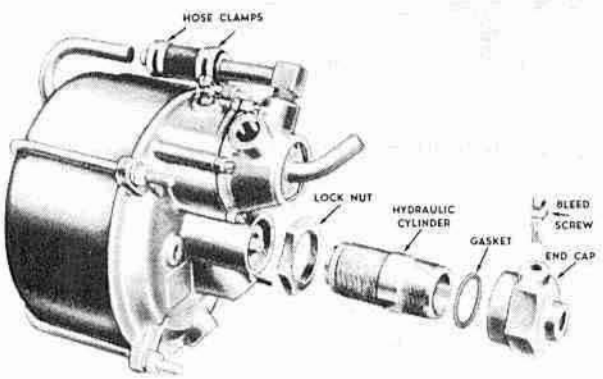

Fig. 5

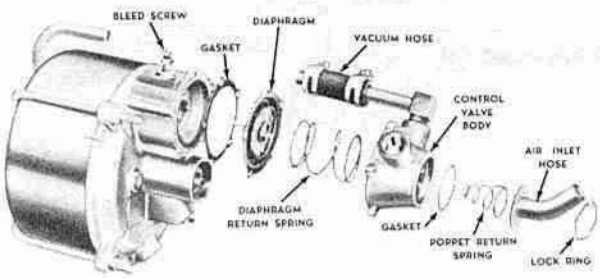

Fig. 6

DISASSEMBLY

Remove the unit from the truck. Loosen hose clamps and slide the hose from the cylinder tube (see Fig. 5). Loosen the lock nut and unscrew the hydraulic cylinder from the end plate. Hold the end cap in a vise and using an open-end wrench on the flat part of the cylinder, unscrew the hydraulic cylinder. Remove the gasket and bleed screw from the end cap.

Remove the control valve housing and valve parts (see Fig. 6). Scribe a line across the cylinder shell and on the end plate so they can be reassembled in their original positions. Remove the hook bolts and the cylinder shell.

Compress the piston return spring by pressing down on the end plate and install the hook clamps as illustrated in Fig. 7. The dimensional sketch in the inset shows how to make these clamps. Remove the hydraulic piston from the push rod by sliding the snap ring or retainer spring back and removing the pin. Remove the hook clamps, allowing the vacuum piston and spring to be removed.

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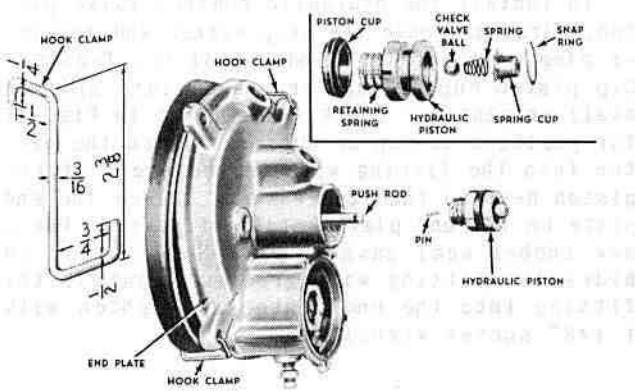

Fig. 7

If the vacuum piston leather or any other part of the piston is damaged, disassemble the piston. (Piston parts are illustrated in Fig. 12 page 128D of the Assembly section.) Disassemble the hydraulic piston by first removing the snap ring, then the spring cup, spring, and ball (see inset in Fig. 7).

Place the end plate over the pins of the end plate holding fixture (see lower inset in Fig. 8 for details of holding fixture). Using special Bendix Tool No. T-25254, remove retainer ring and stop washer. Using 1-1/8" socket wrench, remove the hydraulic valve piston fitting. Press out the valve piston and remove the cup or cups from the valve piston (see inset in upper right of Fig. 8).

Remove the hydraulic cylinder end seal. Remove the snap ring and then remove the push rod seal cup parts (see Fig. 9). Lift the end plate from the fixture and place it upon two wooden blocks; drive out the push rod leather seal assembly with a flat-end rod or drift.

ASSEMBLY

Clean all parts. Immersion in Bendix Metalclene Parts Cleaner is recommended for the metal parts. Dip all metal parts used in the hydraulic system in alcohol before assembly. Use all new parts as furnished in the Hydrovac Repair Kit, which includes new rubber parts (old rubber parts should be discarded). For a complete list of service parts and repair kits, see the Bendix B-K Catalog No. 9-E, Section II, Pages 80-0 to 80-R. If the bore of the vacuum cylinder shell is corroded or rusted, polish with fine emery cloth or steel wool; if badly pitted or scored, use a new cylinder shell.

Press the push rod leather seal into the end plate with the lip of the leather seal toward the hydraulic cylinder side of the end plate. Assemble the push rod hydraulic seal parts (see

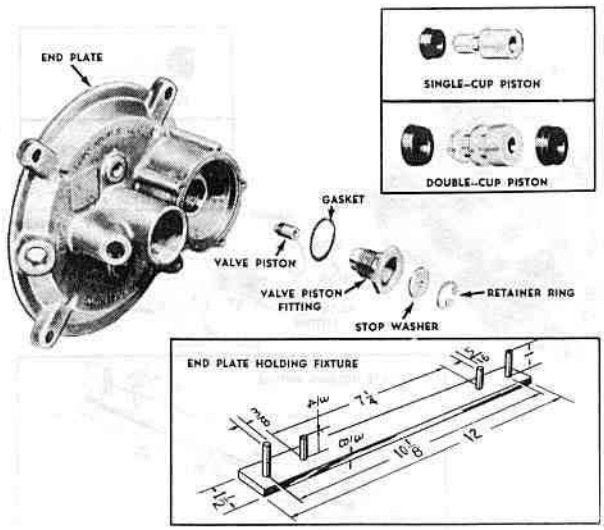

Fig. 8

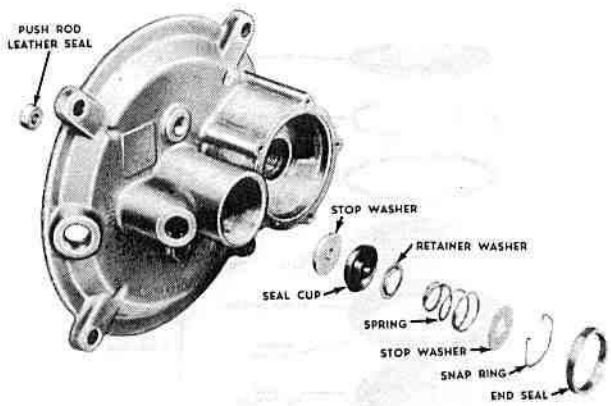

Fig. 9

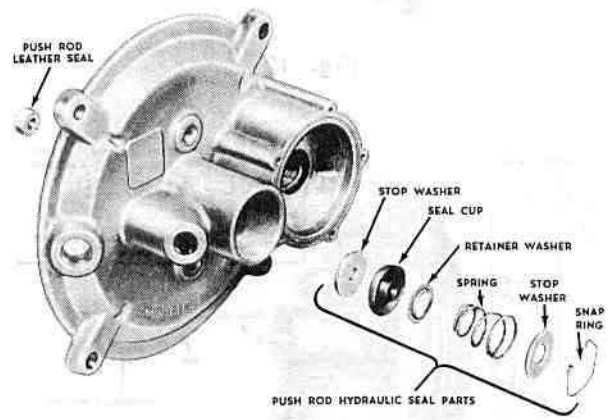

Fig. 10

Fig. 10); stop washer with chamfered side down; seal cup with lip of cup up; retainer washer with flat side next to cup; small end of spring down. Place the stop washer against the spring and install the snap ring in the groove.

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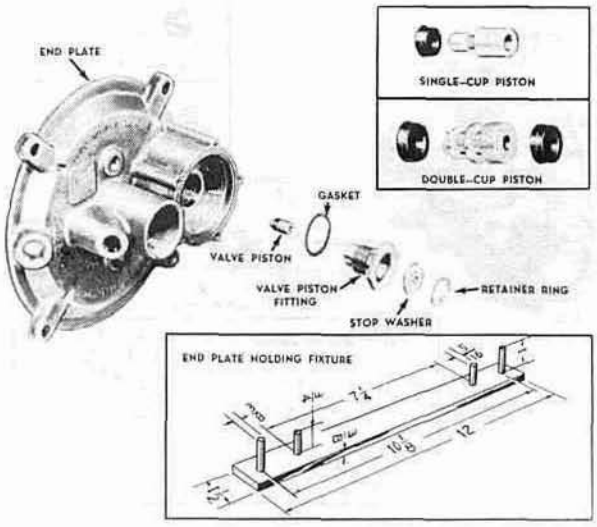

Fig. 11

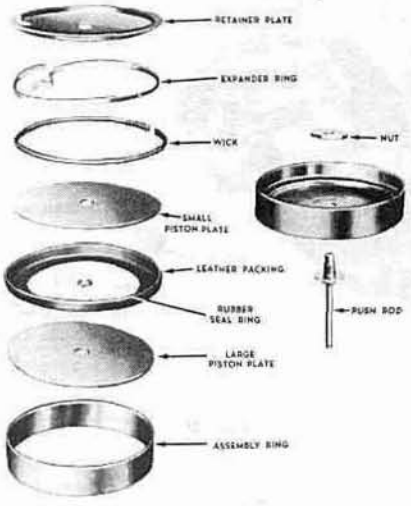

Fig. 12

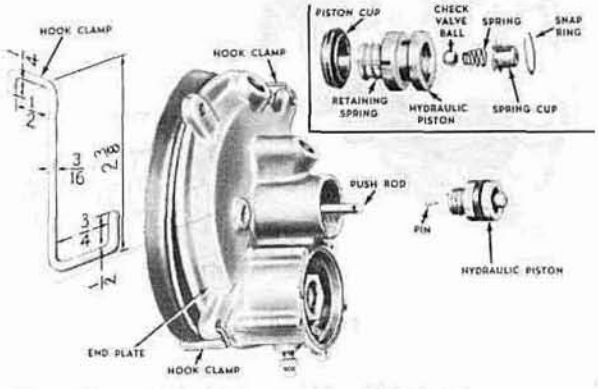

Fig. 13

To install the hydraulic control valve piston, first assemble the stop washer and retainer ring with special Bendix Tool No. T-25254. Dip piston cup or cups in brake fluid and install on piston. (NOTE.--See inset in Fig. 11 for position of cup or cups.) Insert the piston into the fitting with the hole end of the piston next to the stop washer. Place the end plate on the end plate holding fixture. Use a new rubber seal gasket, Part No. 374915, on hydraulic fitting with groove. Install the fitting into the end plate and tighten with 1-1/8" socket wrench.

If the vacuum piston has been disassembled to install new leather piston packing or other parts, reassemble the piston and push rod (see Fig. 12). Drill a 5/16" hole in a bench and place the push rod in the hole with the threaded end up. Assemble piston parts as follows: The flat washer over the threaded end of the push rod; the large piston plate with chamfered side up; guide the rubber seal ring over the threads. Place the assembly ring, Bendix No. SER - 432 or SER - 434, over the piston plate and assemble the following parts: Leather packing with lip of packing up, small piston plate with the chamfered side of hole down. Cut a wick to the required length and assemble against the inner face of the lip of the leather packing; assemble the expander ring inside of the wick with gripper points up and the notch at the loop end of the expander ring under the clip located near the opposite end of the expander ring; retainer plate with cutout portion over the loop of expander ring; thread the nut finger tight onto the push rod. Clamp the hexagonal section of the push rod in a vise and securely tighten the nut. Care must be taken to prevent the retainer plate from shifting while tightening the nut. Stake the nut at two places.

Place the vacuum piston return spring over the push rod with the small end of the spring next to the vacuum piston and carefully guide the push rod through the leather seal in the end plate. Use hook clamps to hold the end plate and the piston together (see Fig. 13). Wash the hydraulic cylinder piston parts in alcohol and assemble the parts illustrated in the inset in Fig. 13. Dip the hydraulic piston cup in brake fluid before assembly.

NOTE.--The lip of the piston protrudes toward check valve end of piston. Attach the hydraulic piston to push rod by means of a retainer pin. Slide the retaining spring over the hole in the piston to hold the retainer pin in place.

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Use new hydraulic cylinder if the bore is pitted or scored. Place new gasket into end cap (see Fig. 14), and thread hydraulic cylinder into end cap with milled flats next to end cap. Tighten securely. Install the bleed screw and thread lock nut on cylinder to the limit of the threads.

Place hydraulic cylinder end seal (see Fig. 15) in end plate against shoulder and guide the lip of the piston cup into the bore of the cylinder. Thread the cylinder in by hand until the end of the cylinder bottoms firmly against the end seal. Do not tighten cylinder or the lock nut at this time.

To install the vacuum piston in the cylinder shell, place a gasket (see Fig. 16) on the end plate. Dip the piston leather in B-K Vacuum Cylinder Oil (do not use ordinary oil) and allow excess oil to drain. Coat the inside of the cylinder shell with B-K Vacuum Cylinder Oil. Insert the piston in the cylinder by tipping the piston as illustrated in Fig. 16. Align the end plate with the scribed marks made during disassembly. Attach the hook bolts and tighten each bolt evenly until all bolts are uniformly tight.

Place the guide pins in the end plate and carefully assemble the control valve parts (see Fig. 17). Guide pins can be made by cutting the heads from No. 8-32X2-1/2" machine screws. Remove the guide pins one at a time and install the screw and lock washer. When assembling the diaphragm, return spring, and control valve body, extreme care should be taken not to distort the diaphragm when compressing the spring. Tighten the hydraulic cylinder to align the bleed screw in the end cap with the bleed screw in the end plate. Tighten the lock nut securely.

Inspect the Hydrovac unit to see that all bolts, nuts, washers, and screws are in place and all tubes, clamps, and fittings are securely tightened. If a Bendix Hydrovac Analyzer is available, test the unit according to the procedure outlined in the manual provided with the Analyzer. If a Hydrovac Analyzer is not available, install the Hydrovac unit on vehicle and lubricate.

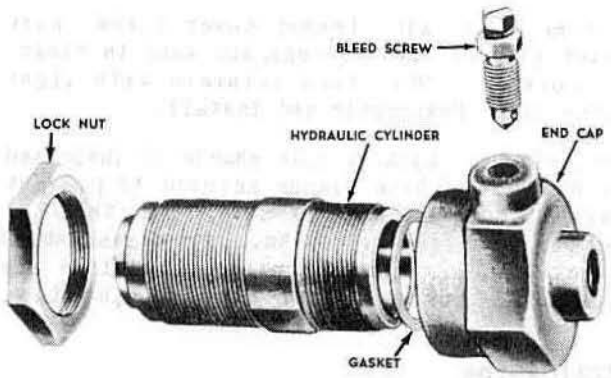

Fig. 14

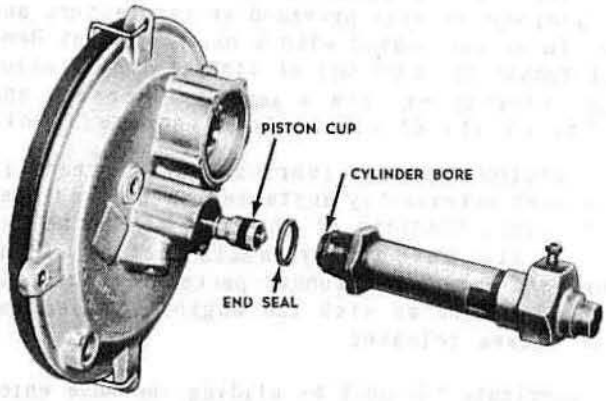

Fig. 15

Fig. 16

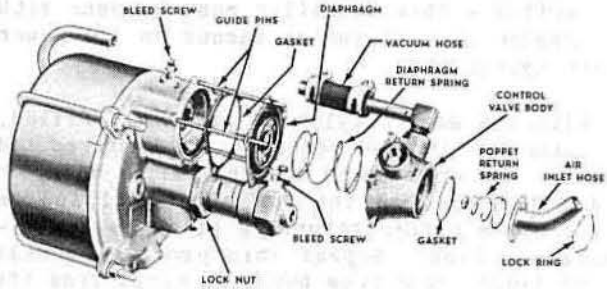

Fig. 17

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SERVICING THE AIR CLEANER

Remove the air cleaner cover screw, hair filter element, and screens, and wash in cleaning solvent. Dry, then saturate with light engine oil. Reassemble and install.

NOTE.--The air cleaner hose should be inspected for damage and hose clamps secured to prevent leakage. The air cleaner should be inspected every 1,000 miles (1.609 km.) and disassembled for cleaning. Where operating conditions are unusually dusty, clean more frequently.

LUBRICATION

Single piston Hydrovacs require lubrication in addition to that provided at manufacture and are to be lubricated with 1 oz. (28 g.) of Bendix Vacuum Cylinder Oil at time of installation and, thereafter, once a year or every 20,000 miles (3.219 km.), whichever occurs first.

CAUTION.--Do not lubricate until the unit has been permanently installed on the vehicle. Otherwise, handling of the unit may cause the oil to flow into the hydraulic portion of the unit and damage the rubber parts. The unit is to be lubricated with the engine stopped and the brakes released.

Lubricate the unit by sliding the hose which connects the Hydrovac control valve to the vacuum shell toward the control valve and injecting (with a gun similar to that used for filling shock absorbers) 1 oz. (28 g.) oil into the tube fastened to the shell. Be sure that the oil is injected well down the curve of the tube and that the oil does not remain in the tube, as it may transfer to the valve and cause damage to hydraulic system rubber parts. Some Hydrovacs are provided with a filler and level plug in the cylinder shell.

MANUAL BLEEDING

Manual bleeding requires filling the master cylinder reservoir and pumping the brake pedal to force fluid through the lines to expel air from the system.

CAUTION.--This operation must be done with the engine stopped and no vacuum in the power brake system.

With the master cylinder reservoir filled, open the No. 1 bleed screw on the Hydrovac and depress the brake pedal to expel air. When the pedal has reached the toe board, close the bleed screw before returning pedal to the release position. Repeat this procedure until solid fluid, free from bubbles, comes from the bleed screw. Check the master cylinder reservoir frequently to insure an ample supply of fluid. Using this method, bleed No. 1 and No. 2 bleed screws on the Hydrovac and then proceed to the vehicle wheel cylinders.

PRESSURE BLEEDING

CAUTION.--This operation must be done with the engine stopped and no vacuum in the power brake system.

Be sure there is sufficient brake fluid in the bleeder tank before starting pressure bleeding and that the pressure is from 10 to 30 pounds per square inch. With the bleeder tank thus prepared, fill the master cylinder reservoir before attaching the hose from the bleeder tank to the reservoir. With the pressure from the bleeder tank applied to the master cylinder, bleed the Hydrovac *first*, starting with the bleed screw on the control valve (Bleed Screw No. 1). When a solid stream of fluid, free from bubbles, is obtained, close this bleed screw securely and bleed the Hydrovac hydraulic cylinder (Bleed Screw No. 2). Finally, proceed to the vehicle wheel cylinders and bleed in the following order: right rear, left rear, right front, and left front.

HYDROVAC TESTING

After assembly of the Hydrovac, tests should be made to assure proper functioning of the Hydrovac unit. Figure 18 illustrates the Hydrovac Analyzer with controls and gages. If the Hydrovac Analyzer is not available, test the Hydrovac on the vehicle, using Bendix SER - 428 Portable Kit and the following procedure:

Install a vacuum gage at the manifold and take a reading; vacuum should be 15" - 18" at idle speed. Remove the vacuum gage and reinstall the lines disconnected. Install the hydraulic gage (with adapters) at one of the wheel cylinders or at Bleed Screw No. 2 on the Hydrovac and connect the other vacuum gage to the trailer control line port at the Hydrovac control valve. With the vehicle engine idling, slowly depress the brake pedal until the vacuum gage connected to the control line port reads exactly zero. When the gage reads zero, the hydraulic gage should read between 700 lb. and 1100 lb. per sq. in. and the check valve line vacuum gage should read above 15".

If, at this point in testing, the specified gage readings are not evident, check all fittings and connections. Again take readings and, if readings are not as specified above, check as follows:

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VACUUM LEAKS, BRAKES RELEASED

With the vehicle engine idling, take a vacuum reading with the vacuum gage between the Hydrovac and the check valve with the brakes in released position. This reading should be above 15". Stop the engine. If the vacuum reading drops more than 5" per minute, a vacuum leak is present which may be caused by one of the following:

End plate or control valve body gasket leaks.

Leaks in Hydrovac hose connections.

Distortion of end plate.

Leakage of atmospheric valve poppet.

Loose vacuum cylinder hook bolts.

Loose control valve body screws.

Large control valve poppet spring not centered in spring retainer.

Faulty check valve.

Loose vacuum line fittings or connections.

CORRECTION:

Tighten all connections and fittings *and replace all faulty parts.*

VACUUM LEAKS, BRAKES APPLIED

Start the engine and allow vacuum to build up to maximum. Apply the brakes beyond the point where the control line gage reads zero. Hold the brakes and stop the engine. If there is an increase in rate of drop over the previous test, this indicates leakage at one of the following points:

Faulty or improperly assembled control valve diaphragm assembly.

Dry or faulty vacuum piston leather packing or leak at hub of vacuum piston.

Faulty control valve poppet and poppet seat.

If the vacuum reading drops more than 5" per min., corrections as indicated under Vacuum Leaks - Brakes Released and Vacuum Leaks - Brakes applied must be performed.

CORRECTION:

Replace faulty parts.

HYDRAULIC LEAKAGE

With the engine stopped and vacuum at zero, depress the brake pedal *moderately.* If the brake pedal "falls away" (drops toward floorboard), the hydraulic system is leaking, *probably caused by one of the following* conditions:

Leaks in master cylinder.

Leaks in wheel cylinders.

Faulty connections or fittings.

If the above test *does not reveal hydraulic* leakage, refer to Section IV of Hydrovac Diagnosis.

HYDROVAC DIAGNOSIS

I. BRAKES DRAG OR WILL NOT RELEASE

(This may not be noticeable until after two or more successive applications.)

Check For:

(a) Master Cylinder Piston Rod Clearance.

Make sure that the linkage is correctly adjusted to permit opening of compensating port with brake pedal in normal, full released position. If compensating port in master cylinder is not being properly uncovered, sufficient pressure may be maintained in brake system to hold Hydrovac valve in partially applied position.

CORRECTION:

Adjust linkage to master cylinder correctly, with brake pedal in full released position. Also check master cylinder to make sure compensating port is not plugged with dirt and piston is returning fully against stop.

(b) Broken Vacuum Cylinder Piston Return Spring.

Vacuum cylinder shell must be removed to check condition of spring. A broken spring will permit piston "return" movement to stop before full released position is reached. It will also prevent proper opening of hydraulic cylinder ball check valve, causing pressure to be maintained in brake system. (This pressure may allow full release of brakes, but release will be delayed or slow.)

CORRECTION:

Replace with proper service parts.

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(c) Broken or Improperly Assembled Valve Diaphragm Return Spring.

Valve body must be removed to check condition of spring. This is the large spring located between the removable valve and body diaphragm assembly. A broken spring permits control valve mechanism to remain in partially applied position.

CORRECTION:

Replace with proper service part.

(d) Sticking Control Valve Piston.

Check the movement of the control valve piston in the adapter bore. Piston must move freely without bind. Stickiness may cause the piston to fail to return to its released position.

CORRECTION:

Clean piston and bore of dirt or any other foreign matter. If cups are swollen, replace with proper service parts and determine cause of swelling. Flush complete brake system with clean brake fluid, if necessary, to remove all foreign substance.

II. BRAKES APPLY WHEN ENGINE IS STARTED

Check for:

(a) Broken or Improperly Assembled Valve Diaphragm Return Spring. (See I (c).)

(b) Broken or Improperly Assembled Atmospheric Valve Return Spring.

Check by removing the valve body cover (air cleaner hose connection elbow and plate assembly). A broken or improperly assembled spring permits the atmospheric and vacuum valve poppet assembly to fall out of line with the diaphragm assembly, allowing the atmospheric valve poppet to remain open. This may cause difficulty in starting the engine, and, after the engine is started, will cause partial application of the brakes.

CORRECTION:

Replace with proper service part, if required, or assemble with original spring in correct position.

(c) Sticking Control Valve Piston. (See I (d).)

(d) Broken Valve Poppet Cable.

Cable can be checked by removing the valve body cover. A broken valve poppet cable permits the vacuum vlave poppet to fall out of position, definitely preventing proper closing, and possibly preventing the atmospheric valve poppet from closing properly.

CORRECTION:

Replace poppets with proper service poppet parts, or use new valve body and poppet assembly.

III. BRAKE PEDAL "KICK-BACK"

(a) Defective or Damaged Hydraulic Cylinder Piston Cup.

Cup can be checked only by removing hydraulic cylinder for inspection. A defective or damaged cup will permit leakage of brake fluid from the high pressure to the low pressure side of the hydraulic cylinder piston. The increase in pressure on the low pressure side of the piston will cause a return movement, or "kick-back" on the brake pedal.

CORRECTION:

Replace cup with service part. Caution.- Be sure all parts - hydraulic cylinder, piston, cup, etc. - are cleaned thoroughly with clean brake fluid before assembly.

(b) Improperly Seated Hydraulic Cylinder Ball Check Valve.

This may be due to a defective seat on the piston, or to dirt, chips, or other foreign matter on the seat. It can be checked *only* by removing the hydraulic cylinder for inspection of the ball and seat. A leak past the ball check valve will cause the same effect as a defective or damaged hydraulic cylinder piston cup. See III (a).

CORRECTION:

Replace ball, if required (or piston, if seat is damaged), with proper service parts. Otherwise, remove all foreign matter from ball and seat before assembly.

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IV. LOSS OF FLUID FROM BRAKE SYSTEM

NOTE.—Hydrovac must be removed from chassis and disassembled.

Check For:

(a) Defective or Damaged Hydraulic Cylinder Stationary Cup (or Seal).

A defective or damaged cup (or seal) will permit leakage of fluid from the hydraulic cylinder into the vacuum cylinder, in front of the piston. From this chamber, it will be drawn into the engine intake manifold through the vacuum line.

CORRECTION:

Replace the cup with the correct service part. Caution.--Make sure all parts are thoroughly cleaned before assembly.

(b) Defective or Damaged Control Valve Piston Cup.

A defective or damaged valve piston cup will permit loss of fluid from the hydraulic system into the vacuum cylinder (as in IV (a).) through the opening between the vacuum chamber in the control valve and the constant vacuum side of the piston in the vacuum cylinder.

IMPORTANT.--In inspecting and checking this cup, be sure to check for a crack or split in the lip at the center of the cup, as well as for chips or other foreign matter under this lip.

CORRECTION:

Replace with correct service part, making sure that all parts are thoroughly cleaned before assembly.

(c) Chips, Dirt, Hair, or other Foreign Matter Under Lip of Hydraulic Cylinder Stationary Cup or Valve Piston Cup.

Any foreign matter under the lips of either of these cups will have the same effect as damaged cups in permitting fluid leakage into the vacuum cylinder portion of the Hydrovac.

CORRECTION:

Replace both hydraulic cylinder stationary cup and valve piston cup with correct service parts and *make doubly sure that all parts are thoroughly cleaned with castor oil or clean brake fluid before reassembly.*

(d) Improperly Tightened or Defective Gaskets or Rubber Seals.

Copper gaskets or rubber seals at the control valve piston adapter and at the hydraulic cylinder cap may leak because of chips, scratches, defective parts, or improper assembly during service. Leakage may also occur at the hydraulic cylinder rubber seal for the same reasons.

CORRECTION:

Remove foreign matter and replace defective parts. Reassemble with care.

V. HYDROVAC FAILS TO OPERATE

Check For:

(a) No Vacuum

With engine running, remove vacuum line from Hydrovac vacuum fitting and test for vacuum with a vacuum gage. If no vacuum exists, or if air flow is "slow", the line from manifold must be clogged or restricted. Check tubing and hose for kinks and hoses for collapsed lines Test check valve to be sure it opens.

CORRECTION:

Replace faulty portions of vacuum line.

(b) Restricted Air Line

Remove air cleaner line at Hydrovac and blow into line. If line is restricted, check for collapsed hose or tubing and for clogged air cleaner.

CORRECTION:

Clean or replace defective parts.

(c) Broken Valve Poppet Cable.

(See II (d).)

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Hydrovac Analyzer available from the Bendix Products Division of the Bendix Aviation Corporation, South Bend 20, Indiana.

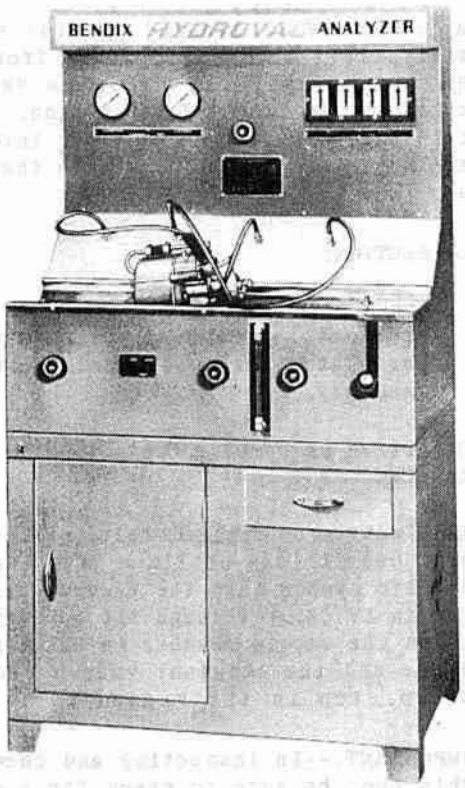

Fig. 18

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WHEELS AND TIRES

WHEEL AND TIRE SPECIFICATIONS

ALL MODELS Wheel and Tire Specifications after truck serial numbers M5-5000, M15-2000, M16-5200, and for the *M15A* from the start of production, are as follows:

Model	Ply	FRONT Size	FRONT Pressure	REAR Size	REAR Pressure
M5	6	6.50x16	36# (2,53 kgs)	6.50x16	36# (2,53 kgs)
M15	8	7.00x20	55# (3,86 kgs)	7.00x20	55# (3,86 kgs)
	8	7.50x20	55# (3,86 kgs)	7.50x20	55# (3,86 kgs)
M15A	6	7.00x17	45# (3,16 kgs)	7.00x17	45# (3,16 kgs)
	8	7.50x17	55# (3,86 kgs)	7.50x17	55# (3,86 kgs)
	8	7.00x20	55# (3,86 kgs)	7.00x20	55# (3,86 kgs)
	8	7.50x20	55# (3,86 kgs)	7.50x20	55# (3,86 kgs)
M16	8	7.00x20	55# (3,86 kgs)	7.00x20	55# (3,86 kgs)
	8	7.50x20	55# (3,86 kgs)	7.50x20	55# (3,86 kgs)
	10	8.25x20	60# (4,22 kgs)	8.25x20	60# (4,22 kgs)

HUBS AND DRUMS

M15 AND M15A MODELS *Integral hubs and drums* are used after truck serial number M15-2000, and on *the M15A from the start of production; that is, the* wheel hubs and brake drums are of one-piece design *and cannot be removed separately.*

M16 MODELS All the wheel hub studs and nuts, after truck serial number M16-5200, have right hand threads.

SYNTHETIC TIRES AND TUBES

GENERAL—ALL MODELS Synthetic tires and tubes are used after truck serial numbers *M5-5000, M15-2000,* M16-5200, and on the M15A from the start of production. Since *the characteristics of synthetic* rubber differ considerably from those of natural rubber, it is important that *all dealers and service men,* as well as truck operators, learn to recognize and accept these differences. The *following information* outlines important service and repair procedures, and highlights several precautionary *measures.*

Synthetic rubber tire treads are not as resistant to cuts and tears as natural rubber, especially when the tread is hot. For this reason synthetic tires *require more frequent inspection for cuts, so that repairs can be made before serious damage is done to the casing.*

The temperature of a tire is affected by the load carried, running speed, temperature of the pavement, the atmospheric temperature, and inflation pressure, especially if the tire is under-inflated. Since excessive heat is particularly destructive to synthetic tires, overloading or excessive speeds should be avoided.

HOW TO INSTALL SYNTHETIC TIRES AND TUBES

1. Inspect the inside of the tire casing and remove any dirt or other foreign matter.
2. Insert the deflated tube in the casing and inflate just enough to round it out, placing valve at the balance mark.
3. Make a solution of water and Firestone Tube Mounting Compound or other high grade soap, and work it into a heavy suds.
4. Dip a cloth or sponge in the suds and swab thoroughly all around the base of the tube, between the tube and the beads of the tire casing, and on the face of the beads. (See figure 81.) The soap acts as a lubricant and reduces the friction as the tube passes over the beads down into the well of the wheel rim when inflated.
5. Lay the wheel flat with the valve hole up.
6. Start to mount the tire with the valve pointing toward the valve hole.

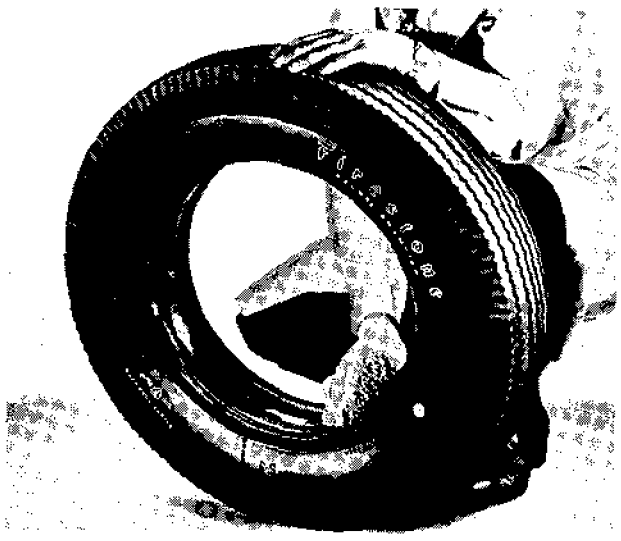

Fig. 81

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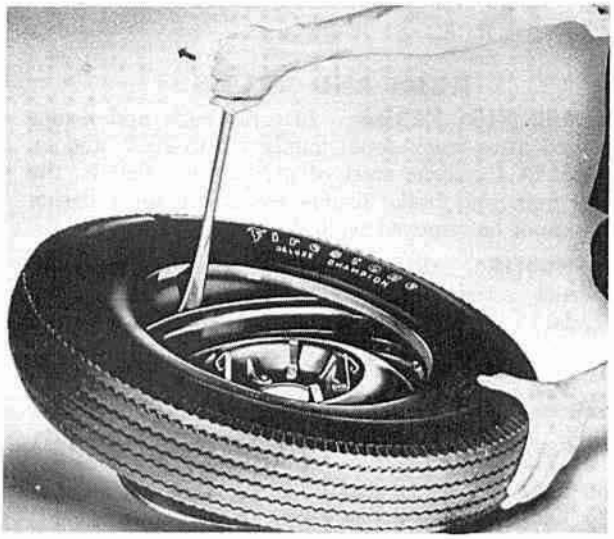

Fig. 82

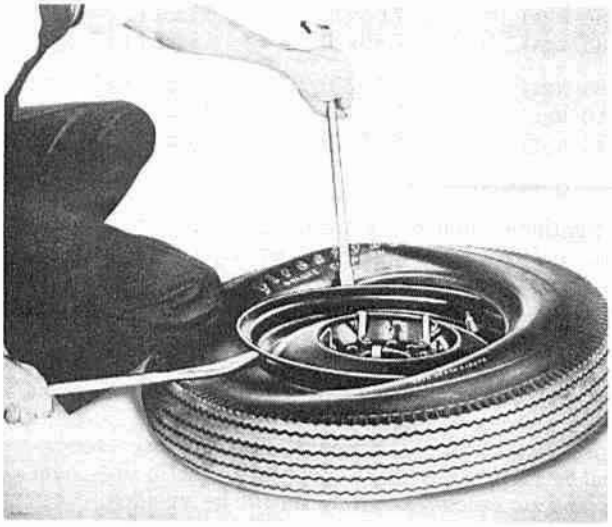

Fig. 83

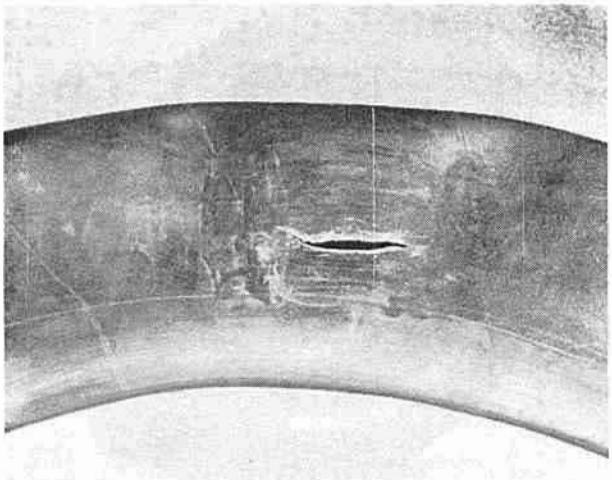

Fig. 84

7. Apply the first bead by pushing a portion of it into the well of the rim; then work the remaining part over the flange with a tire tool. (See figure 82.)
8. Spread the tire and place the valve stem through the hole in the rim. The use of a valve fishing tool or valve extension will aid in pulling the valve into position.
9. Apply the second bead by forcing the portion of the tire *opposite* the valve down into the well of the rim; then work the remainder of the bead over the flange with tire tools, alternating from right to left to prevent the tire from creeping on the rim. (See figure 83.)
10. Make certain that the beads are out of the well and in position to seat properly against the flange, then pull the valve out so as to hold the base snugly against the rim.
11. While holding the valve in this position, inflate the tire until both beads are seated, with the centering ribs (when marked on the tire) showing evenly above the rim flange.
12. Deflate the tube completely to allow it to adjust its position in the tire and to prevent it from being pinched under the tire beads.
13. Reinflate to the recommended pressure for use.

VULCANIZED REPAIR OF SYNTHETIC TUBES There are two types of synthetic rubber used in the manufacture of tubes — GRS and GRI — the latter being identified by a blue stripe on the rim area and/or the letter "I".

GRI synthetic tubes are repaired exactly the same as natural rubber. Inner tubes made of GRS synthetic rubber tear more readily than natural rubber tubes; therefore, extreme care must be used in making repairs.

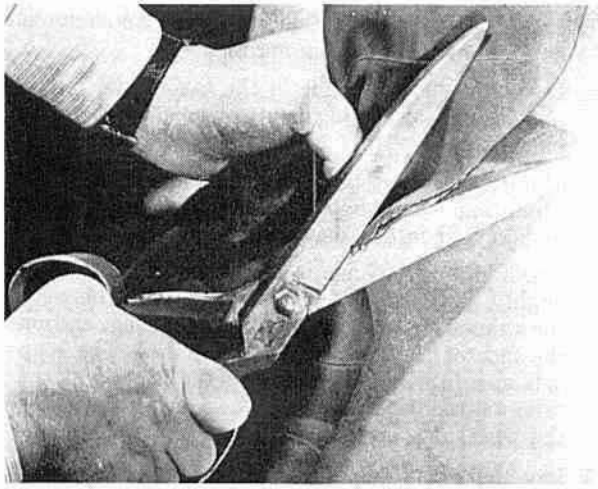

Fig. 85

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Following are detailed instructions for repairing GRS tubes as issued by the Firestone Tire and Rubber Company:

1. Trim the edges of the injury, such as shown in figure 84, on a 45° bevel with a single cut of a pair of sharp scissors. Remove all corners and sharp edges, rounding out the ends to eliminate sharp corners and to prevent tearing. An easy way to do this is to hold the edges of the injury together, as shown in figure 85, turning the scissors at the start and finish so as to round out the edges of the injury. (See figure 86.)
2. Roughen the surface of the tube around the injury with a wire brush for at least 1″ (25,4 mm) in all directions. *Buffing must be done radially (not circumferentially), and deep scratches must be avoided.*
3. Wash the buffed area, as well as the inside of the tube surrounding the injury, with Firestone Rubber Solvent, using a clean cloth. (See figure 87.) Apply one coat of Firestone Tube Vulcanizing Cement inside and out. Allow the cement to dry.
4. Cut a piece of Firestone Combination Tube Gum for application inside the tube. This piece should be 1/2″ (12,7 mm) larger in all directions than the injury. Dip the combination gum in Firestone Rubber Solvent and insert under the injury on the inside of the tube, leaving the tan gum (uncured) side exposed. (See figures 88 and 89.) Roll the patch *firmly into place* under the injury after the solvent has evaporated. Care must be taken to obtain thorough adhesion.

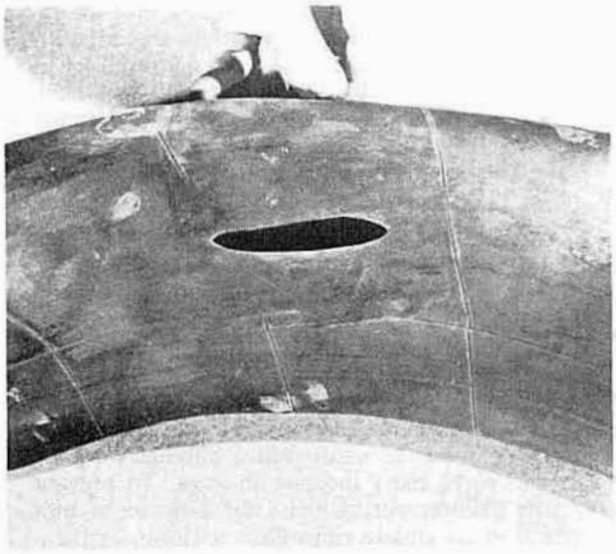

Fig. 86

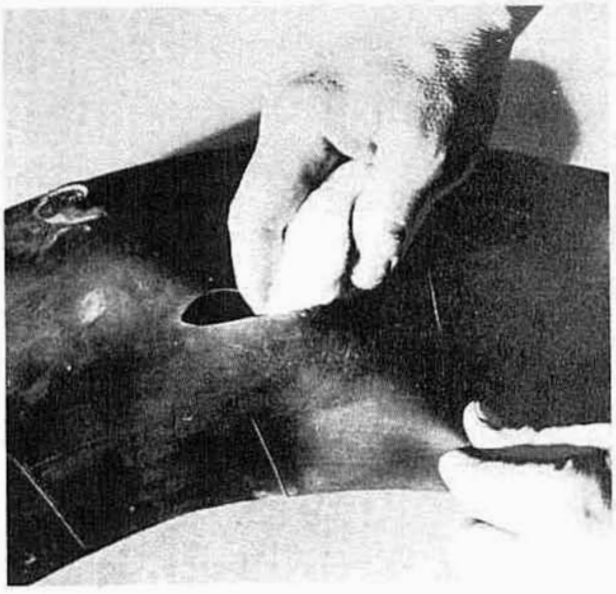

Fig. 87

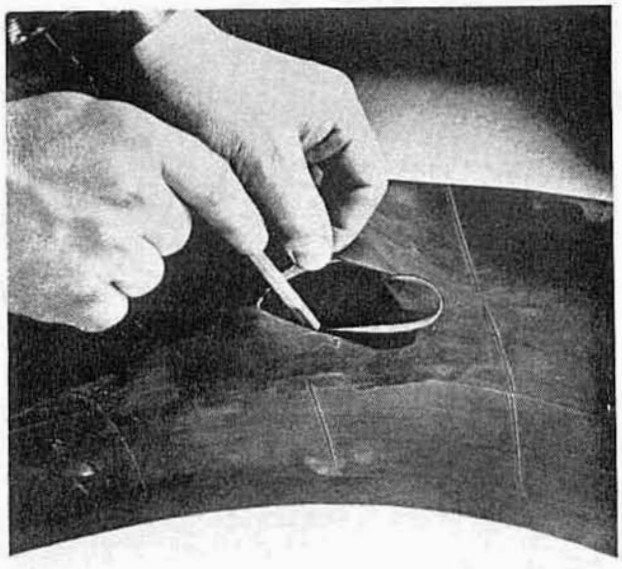

Fig. 88

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5. Cut a strip of Firestone Tube Repair Gum 1/4" (6,35 mm) wide and roll thoroughly into the injury until it is slightly higher than the adjacent tube. (See "B" in figure 89, and figure 90.) Cut another piece of Firestone Tube Repair Gum large enough to extend at least 3/4" (19,05 mm) beyond the injury in all directions. (See figure 91.) The oustide patch and the inside patch must be of different widths to avoid concentration of flexing.
6. Roll the outside patch thoroughly into place. (See "C" in figure 89.) Be sure to obtain thorough adhesion. Dust the repaired area with cornstarch, soapstone, or talc. Cure for 10 minutes at 298° for tubes of 1/16" (1,59 mm) gage. This temperature is the same as that used for vulcanizing natural rubber tubes and the same vulcanizing equipment can be used. Add 5 minutes for each 1/32" (0,79 mm) increase in gage. To prevent repair failure, curing must be done on a unit which has a closely controlled, uniform temperature.

Fig. 89

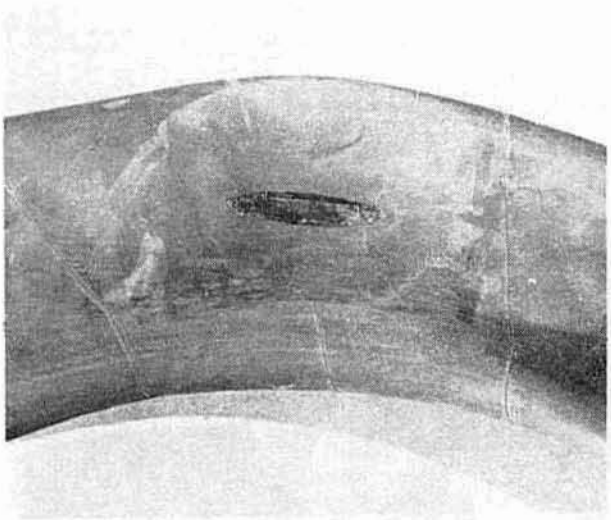

Fig. 90

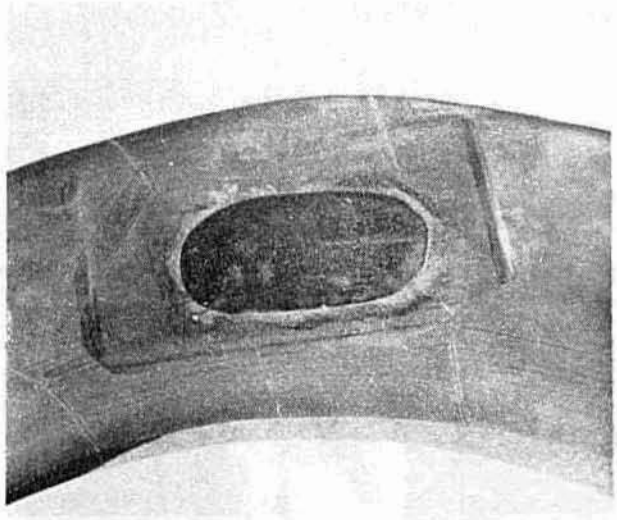

Fig. 91

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I N D E X

This index covers the material in the Shop Manual and Supplement as it applies to the M5, M15, M15A and M16 models. The sections and all items within each section are listed alphabetically in the index.

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